PHYSICAL INSTRUMENTS APPARATUS AND SUPPLIES

MILVAY
SCIENCE
SUPPLIES

CATALOG Nº 42

CHICAGO APPARATUS COMPANY

SCIENTIFIC INSTRUMENTS APPARATUS AND SUPPLIES FOR THE PHYSICS LABORATORY

MILVAY
SCIENCE
SUPPLIES
TRADE MARK REG. U.S. PAT. OFF.

CATALOG No. 42

ESTABLISHED 1908

CHICAGO APPARATUS COMPANY

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» FOREWORD «

IT IS not possible for the skilled artisan to efficiently do his work unless he has good tools and a sufficient variety of them to meet his several requirements. It is just as falacious to expect the skilled science instructor to properly present his science courses and give the full benefit of his knowledge to the students in his class without enough science equipment or without equipment of dependable quality.

● In this catalog we describe and illustrate the "tools" that aid the instructor in his effort to impart scientific facts to his class. How well he succeeds depends not only on his ability and previous training but also on the amount of assistance he can draw upon from his shelves of apparatus and supplies. The listing of science materials presented here is most complete. Furthermore, and of utmost importance every item listed is built as ruggedly as the requirements of the piece will permit and allowing an ample reserve of strength to withstand more than ordinary handling. In brief, dependability is an outstanding characteristic of all science laboratory equipment of MILVAY name and bearing the MILVAY guarantee of quality.

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Our splendid manufacturing facilities enable us to execute orders for special apparatus promptly and at reasonable cost. Blue prints or drawings giving full details should accompany orders for special apparatus.

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All goods purchased from us are guaranteed to comply with the specifications in this catalog and to give complete satisfaction. Any items which are found to be otherwise, may be returned, for credit or exchange, at our expense.

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CHICAGO APPARATUS COMPANY

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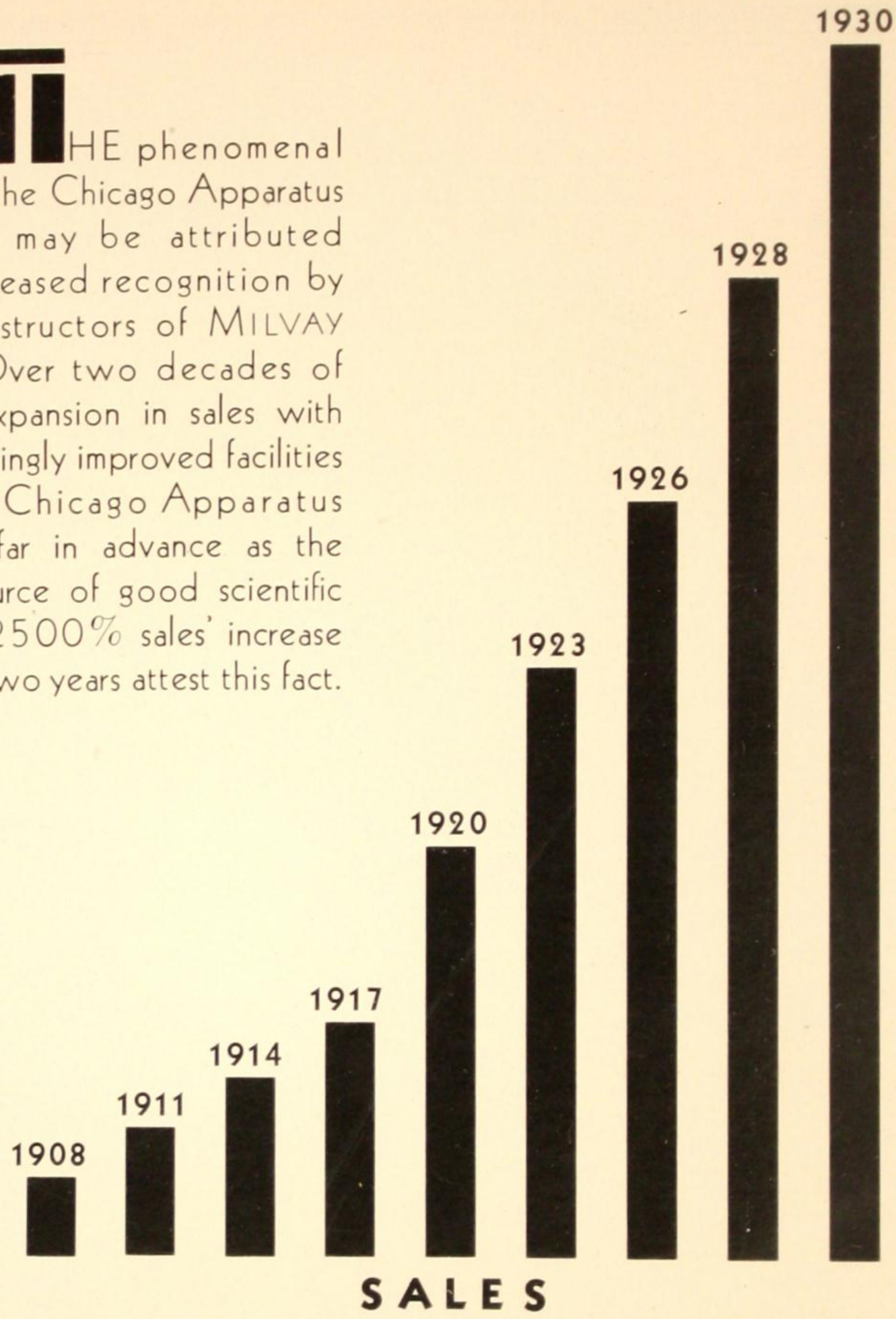
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THE phenomenal growth of the Chicago Apparatus Company may be attributed to the increased recognition by science instructors of MILVAY quality. Over two decades of constant expansion in sales with correspondingly improved facilities place the Chicago Apparatus Company far in advance as the leading source of good scientific supplies. 2500% sales' increase in twenty-two years attest this fact.



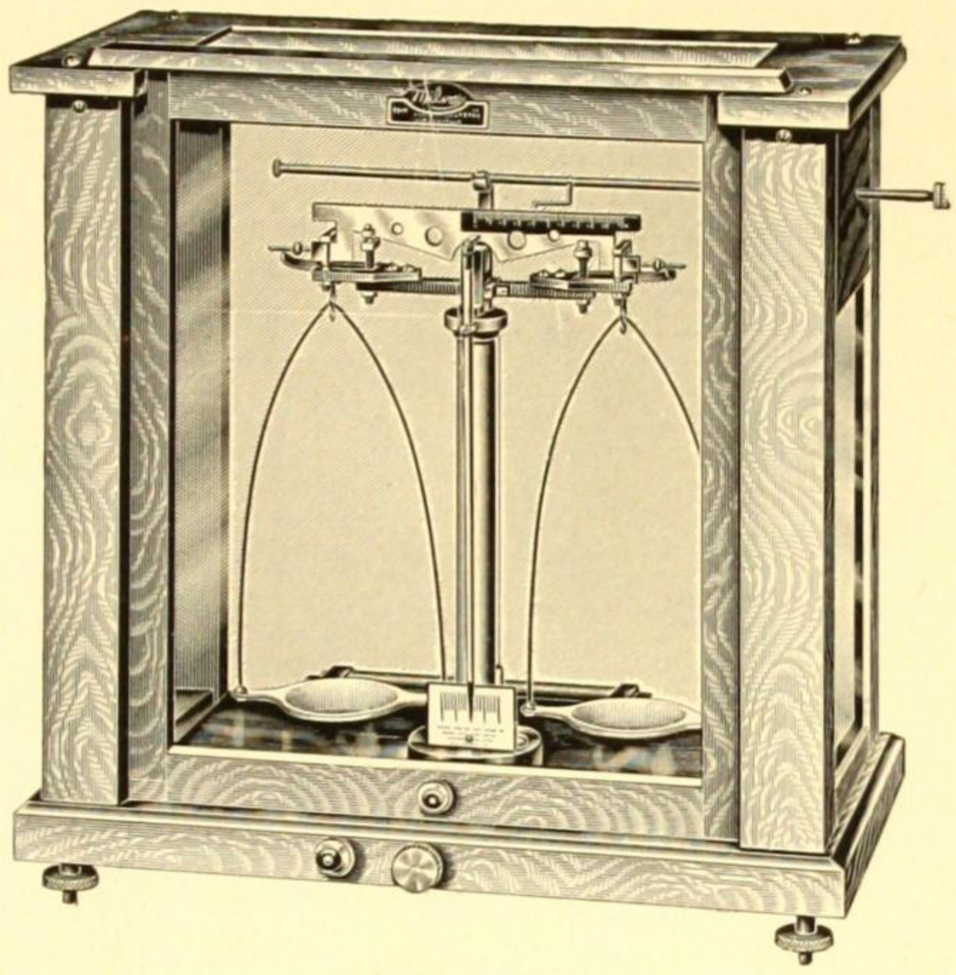
OUR GUARANTEE

WE GUARANTEE that any materials purchased from us will meet with the complete approval of the purchaser. If, for any reason, anything that we furnish is not entirely satisfactory, it may be returned at our expense for full credit or refund. « « « « « « « « « « «

CHICAGO APPARATUS COMPANY

Balances and Weights

Section B



No. 14B

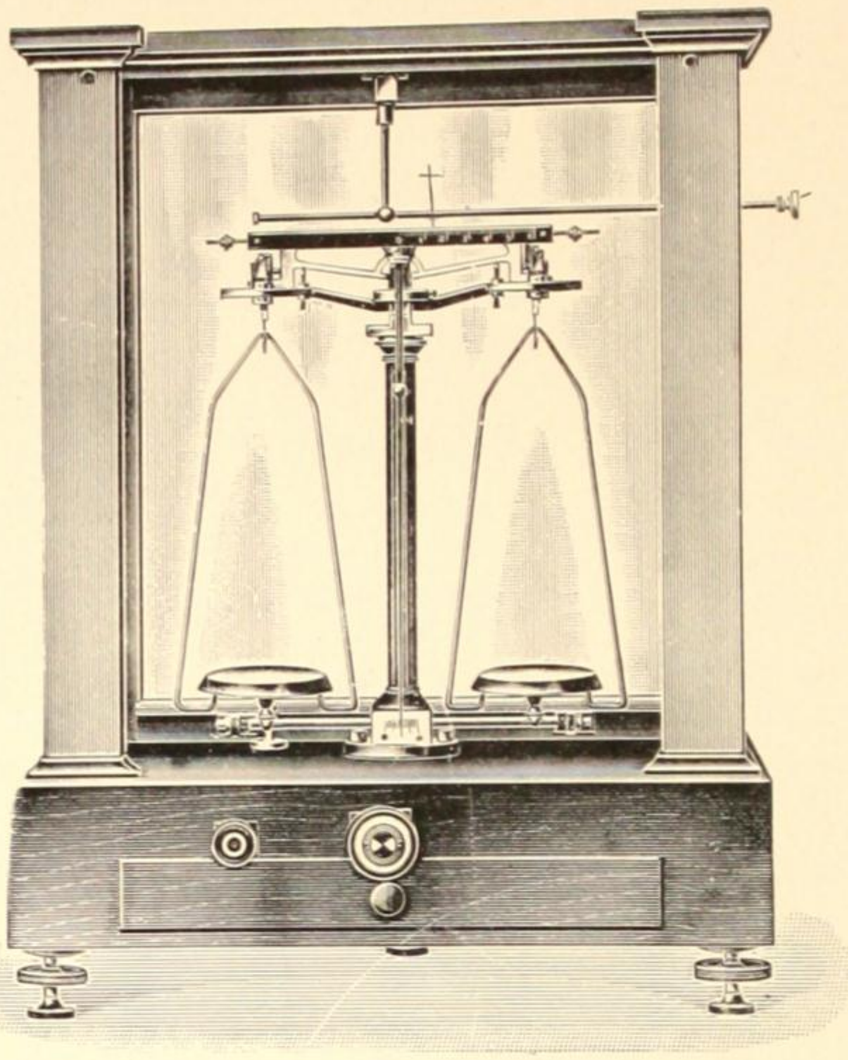
14B. Balance, Analytical, 200 gr. x 1/10 mg. A high grade analytical balance at a low cost. The workmanship is of the highest grade and only selected materials enter into its construction. Quantity production with special labor-saving equipment makes the low price possible. Fully guaranteed by the maker and ourselves. Returnable at our expense if not found highly satisfactory in every way.

Special Features

1. Knife edges and bearings of agate—insures high and permanent sensitivity.
2. Short-beam provides short periods of oscillation.
3. Beam, pans and hangers provided with independent arrests.
4. Legible beam graduations, white on black background.
5. Legible index plate, black on white background.
6. Free from corrosion—no steel used in construction.
7. Improved rider carrier with patent hook.
8. Counterpoised sliding front door.
9. Genuine mahogany case with glass top and sides.
10. Circular level for accurate leveling.
11. Slate base—indestructible, will not warp.
12. Fully guaranteed by the makers and ourselves.

Specifications

Beam, polished aluminum, 6 inches long, graduated in 1/5 mg. divisions, 50 divisions to the right of center. Agate knife edges and planes. Genuine polished mahogany case, 16½x16½x9¼ inches, with counterpoised sliding front door, glass top and sides, and leveling screws. Heavy indestructible non-warping slate base. Circular spirit level and improved rider carrier. Capacity, 200 grams. Sensitivity, 1/10 milligram. Including 10 mg. rider..... **$57.50**



No. 16B.

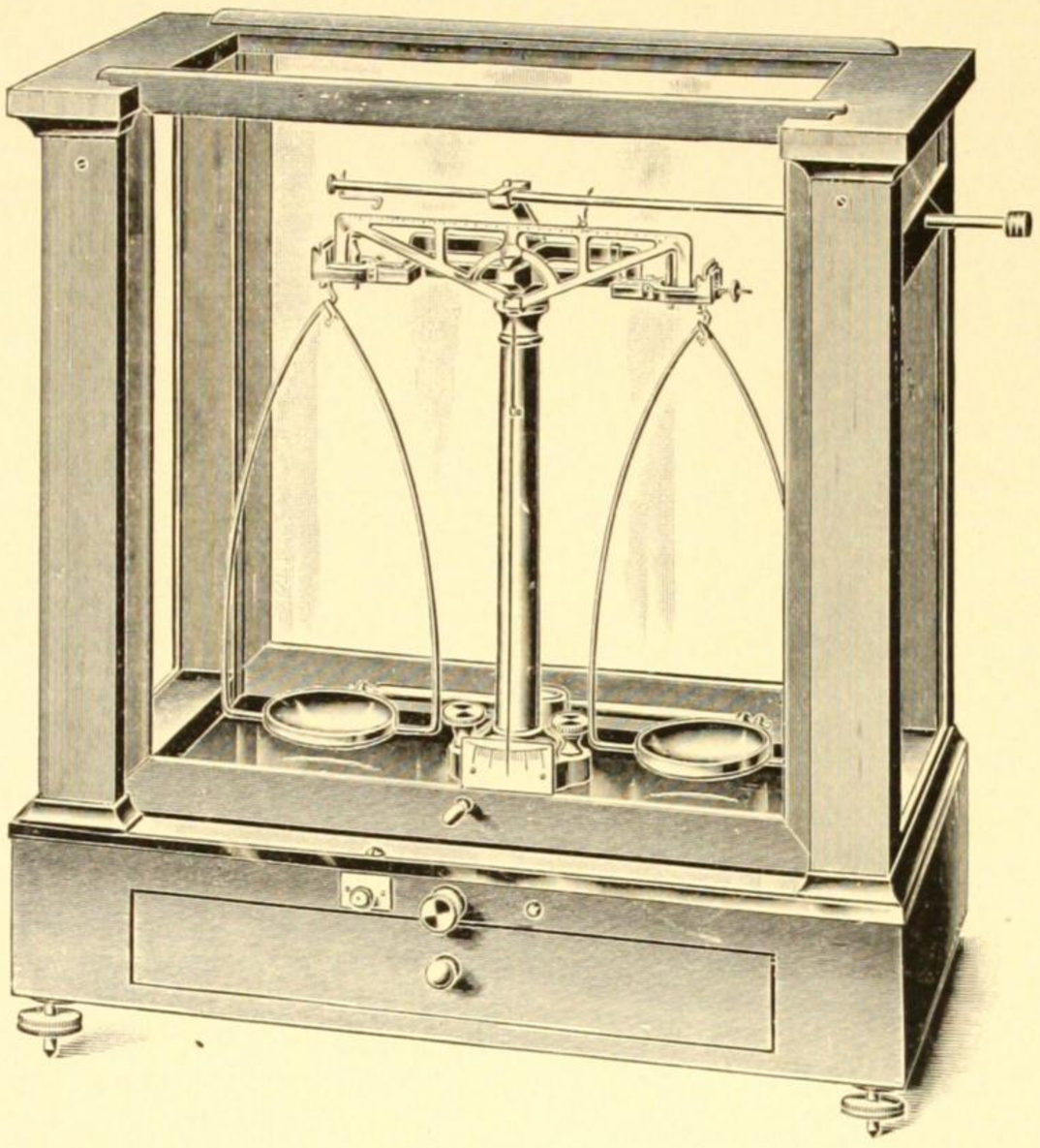
16B. Balance, Analytical, College Model, 100 gr. x 1/20 mg. A real fine balance at a low price. Its sensitiveness, capacity, and rugged construction make it especially suited to the needs of college laboratories. The fall-away beam arrestment, the brush-tipped pan arrestment, and the rider carrier all function with the utmost ease and smoothness. All are provided with external knobs to permit manipulation with the case closed.

The beam, of special aluminum alloy, is of the short-arm type, and therefore has the advantage of short oscillation periods. The right half is graduated for use of a 6 mg. rider. The knife edges and supporting planes are of finest agate. All metal parts are of finest workmanship, elegantly finished, and covered with protective lacquers.

The case is of finely polished mahogany with glass in top and all four sides. The front door is counterpoised. It slides up and down freely and easily, and stays at any point to which it may be raised or lowered. The base is provided with drawer and levelling screws.

Specifications

Capacity	100 grams
Sensitiveness	1/20 mg.
Weight of rider	6 mg.
Dimensions of case	16¾x20½x9½ inches
Length of beam	7 inches
Diameter of pans	2½ inches
Width of bows	4¼ inches
Price, including 6 mg. rider	**$80.00**



No. 18B.

18B. Balance, Analytical, Precision Model, 200 gr. x 1/20 mg. This balance is unequalled for research and advanced work requiring the highest accuracy. It is made for us by a European firm which for over 70 years has specialized in the manufacture of precision balances and whose products have won the highest awards at the London, Vienna, Stuttgart and Paris Expositions. There is no finer example of the balance maker's art. In every detail, material and workmanship are of the highest order. Every refinement by which accuracy and rapidity are facilitated have been embodied in this balance.

Many of these refinements were introduced by the maker over 20 years ago and although since widely copied by others, have defied all efforts at further improvement. In offering this balance to our patrons we do so with the knowledge that it has for over 20 years given experts in research work the utmost satisfaction; that it has won high honors at leading expositions; that it is backed by the 70-year record and reputation of one of the world's leading balance makers; and that it is unconditionally guaranteed by both the maker and ourselves.

The beam, of special aluminum alloy, is of the short-arm type. This provides short periods of oscillation. The top edge of the beam is for use of 10 mg. riders and is graduated into 1/10 mg. divisions. The knife edges and planes are agate, with fall-away arrestments of the beam and stirrups. The arrestment of the pans is by means of a special mechanism and is self locking. So that the arresting mechanism may be operated while the case is closed, the control knobs are conveniently located on the outside center of the base. The improved rider carrier makes placing and moving of the rider easy and sure. The balance is mounted on a black glass plate in a finely finished polished mahogany glass case with counterpoised front door. The sash at the back is removable for convenience in weighing pipettes and other long slender objects.

Specifications

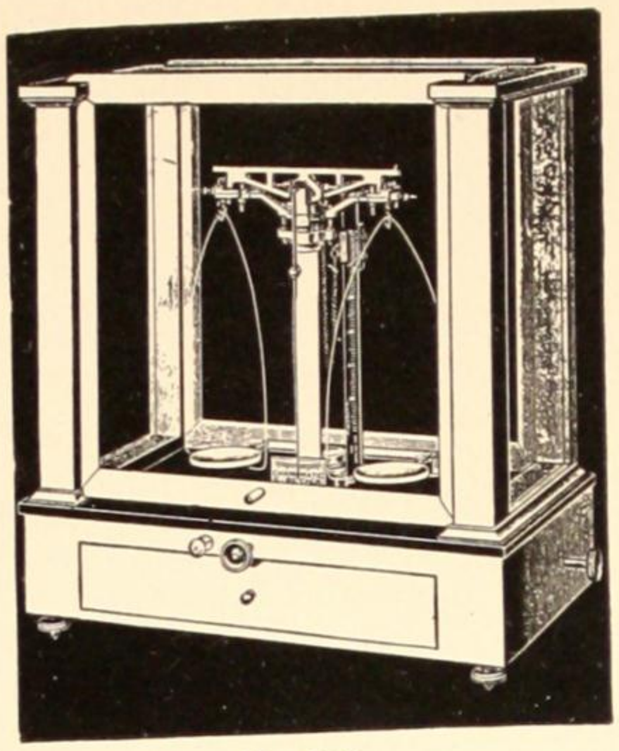
Case—16¾x20½x9½ inches. Capacity, 200 grams.

Beam—7 inches long. Sensitivity, 1/20 milligram.

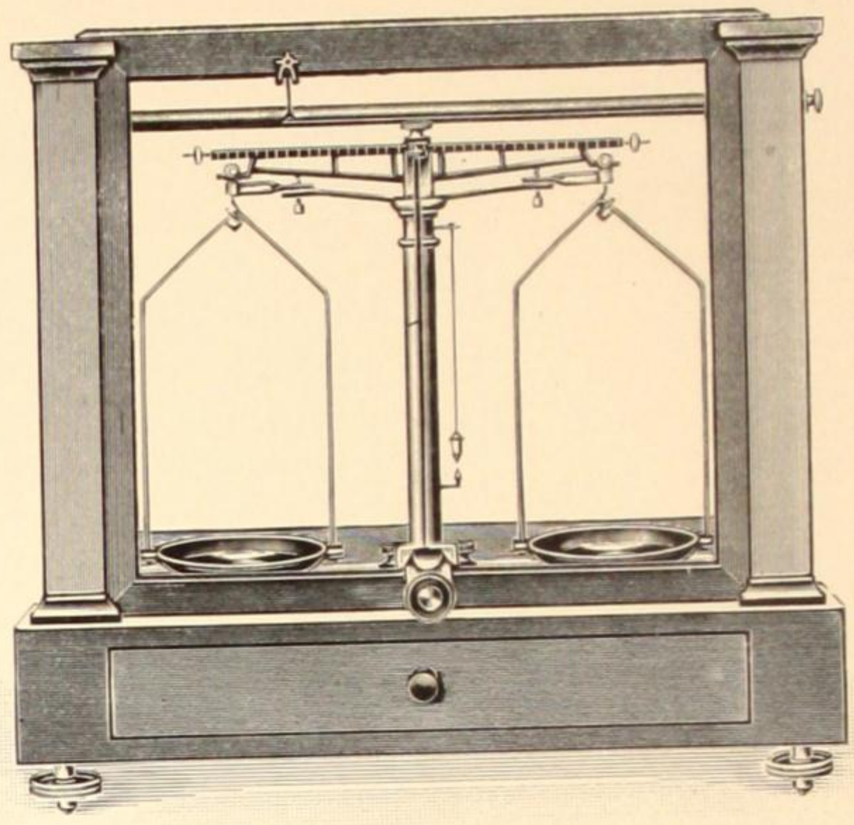
Pans—2½ inches in diameter. Rider, 10 milligrams.

Width of bows—4¼ inches.

Price, including rider **$125.00**



No. 25B.



No. 36B.

25B. Balance, Analytical, 200 gr. x 1/20 mg. Christian Becker Chainomatic No. 8-A. An American made balance of the finest quality. Widely used in educational, industrial and Government laboratories. The old and slow rider carrier system common to other analytical balances has been done away with. A fine link gold chain, attached at one end to the beam and at the other to a Vernier which slides on a graduated vertical column, takes its place.

The Vernier is operated by a spiral drive controlled by a knurled head on the outside of the case. By this means all weighings from 1/10 Milligram to 50 Milligrams can be made without opening the case or using the beam arrest. The Vertical column is calibrated in Milligrams and the Vernier makes possible direct readings to the tenth part of a Milligram. There are no small weights to handle and add, and no rider to move back and forth. These advantages facilitate rapidity and accuracy of weighings.

Beam—Bronze, of great density and tensile strength, 7 inches long.

Case—Polished mahogany, glass sides and top, counterpoised sliding front door, polished black plate glass base inside of case. Outside dimensions: 16½x18½x9¼ inches.

Bearings—Agate planes.

Knife Edges—Agate.

Release and Arrest—Independent arrest for pans with automatic stop.

Pans—Polished nickel-silver, 2⅜ inches diameter.

Pan Supports—Polished nickel-silver wire with 4⅛ inch spread.

Capacity—200 grams.

Sensitivity—1/20 Milligram under full load.

Price includes specific gravity support and holder for weighing test tubes, with counterpoise. **$190.00**

26B. Balance, Analytical, 100 gr. x 1/20 mg. Christian Becker Chainomatic No. 15. This balance has been especially designed for routine laboratory work. Like our No. 25B, it is also equipped with the chainomatic device, eliminating riders and fractional weights up to 50 mg. While the rated capacity is 100 grams, the construction is so sturdy that loads as high as 200 grams may safely be weighed. Under such loads the sensitivity is 1/10 Milligram.

Beam—Aluminum alloy, 6 inches long.

Case—Polished mahogany, front sliding frame counterpoised. Mounted on black plate glass. Outside dimensions: 16½x18½x9¼ inches.

Bearings—Agate planes.

Knife Edges—Agate.

Release and Arrest—Independent arrest for pans with automatic stop.

Pans—Polished nickel-silver, 2⅜ inches diameter.

Pan Supports—Polished nickel-silver wire, with 4⅛ inch spread.

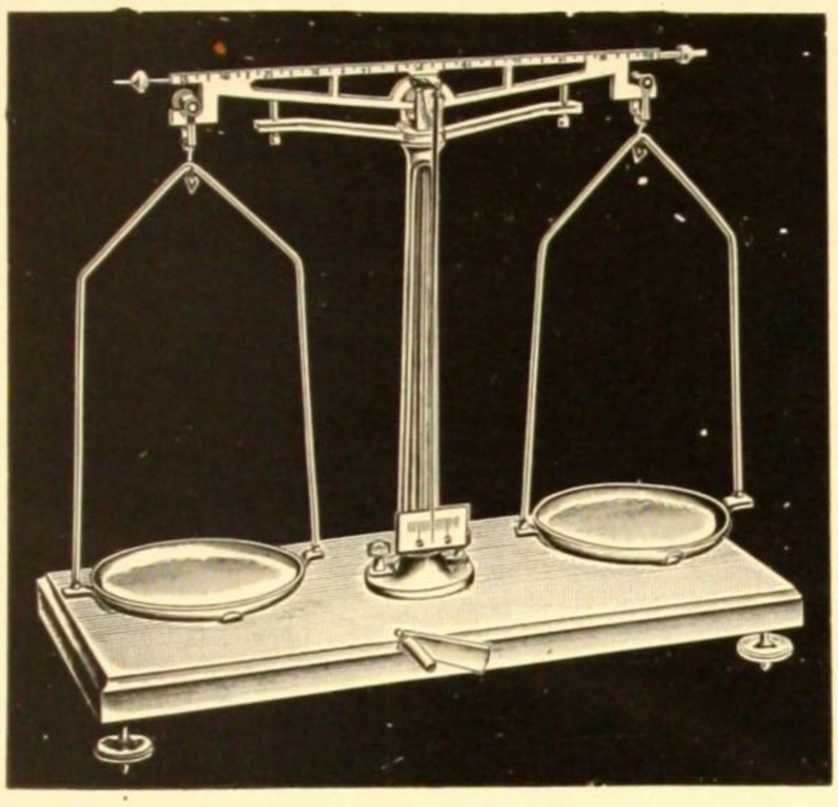
Capacity—100 grams: 200 grams.

Sensitivity—1/20 mg. under load of 100 grams and 1/10 mg. under load of 200 grams.

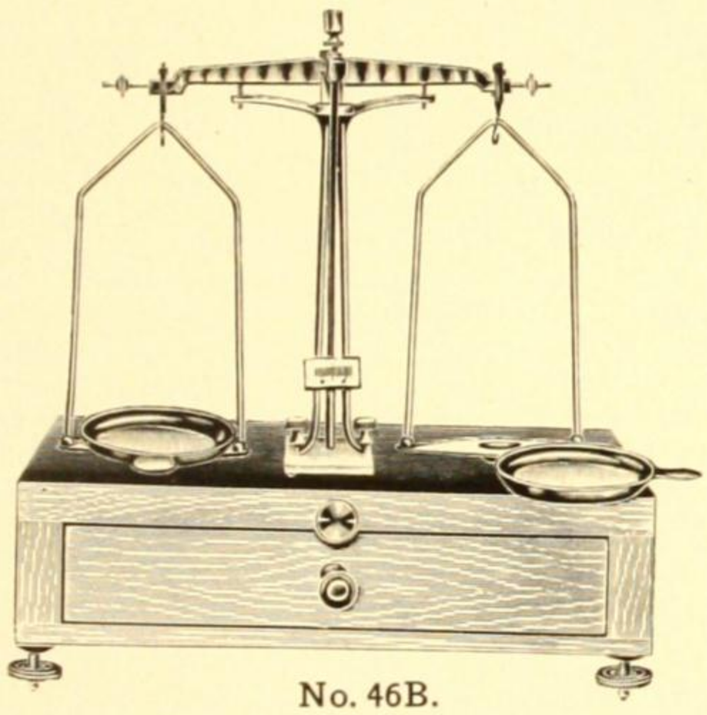
The most accurate and most rapid balance ever constructed for routine laboratory work. **$150.00**

36B. Balance, Chemical, Precision Type, 100 gr. x 1 mg. This new low-priced balance, made for us by European balance makers with a record and reputation extending back 70 years, has special features and refinements found ordinarily only in balances selling at much higher prices.

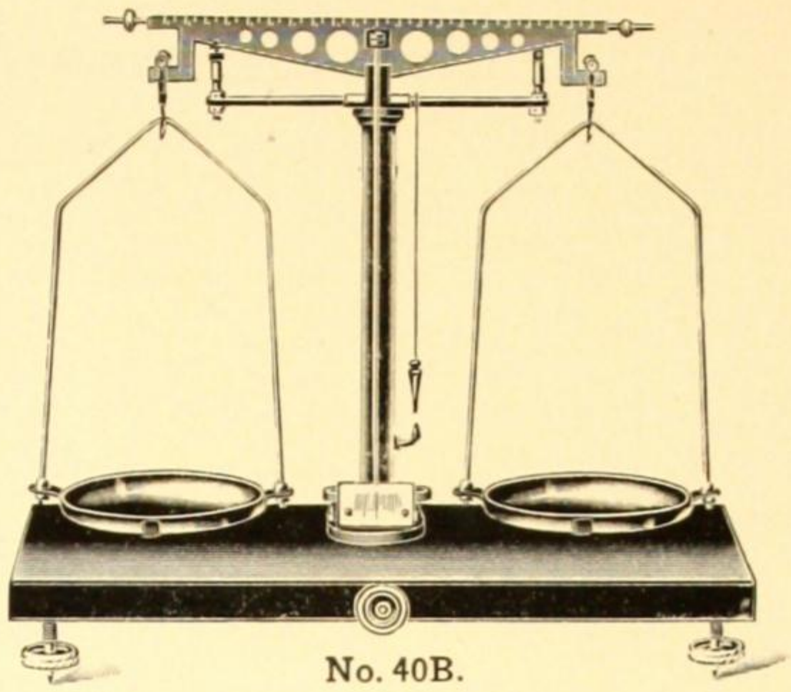
Bearing and knife edges are of agate, the center plane being perfectly flat and rigid. The open beam is of the short-arm type, 7 inches long. This provides short periods of oscillation. Arrestment for beam and hangers releases end as well as center knife edges. Milled head is on the outside so arrestment may be operated when the case is closed. Pans are nickel-plated, 8 cm. in diameter, and removable. The beam is graduated along the upper edge for rider. Improved rider-carrier makes the placing and moving of the rider sure and easy. Pillar and support are black lacquered and provided with plumb bob. Mounted in mahogany glass case with drawer and leveling screws. Price, including 10 milligram rider **$38.50**



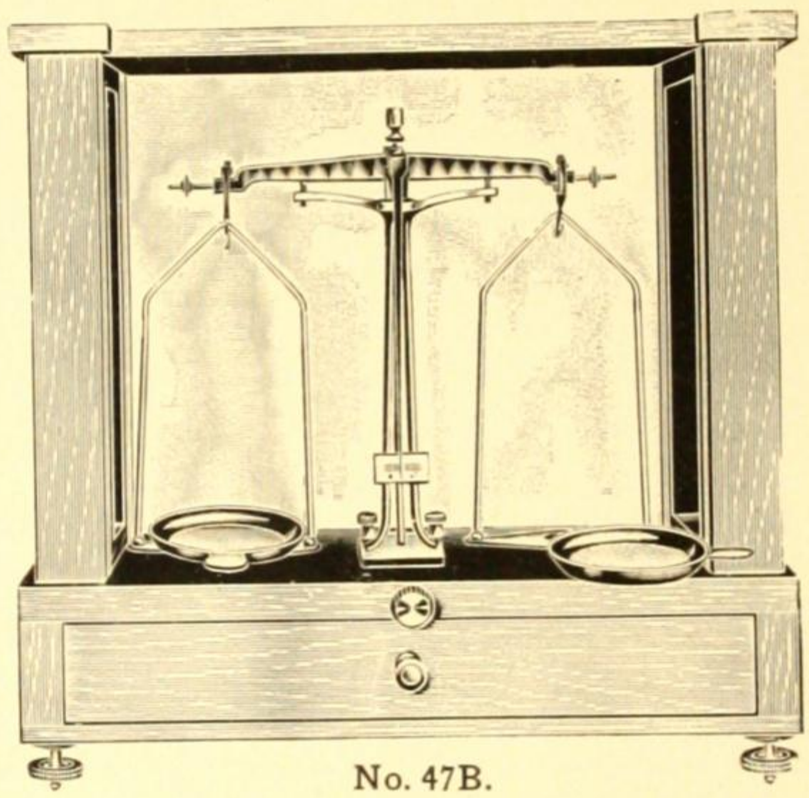
No. 42B.



No. 46B.



No. 40B.



No. 47B.

40B. Balance, Chemical, Precision Type, 100 gr. x 2 mg. This new low-priced balance, made for us by European balance makers with a record and reputation extending back 70 years, has special features found ordinarily only in balances selling at about double the price.

Bearings are of agate, the center plane being perfectly flat and rigid. Knife edges are of steel. Beam is of aluminum provided with adjusting screws at both ends and graduated along the top edge for rider. A milled head on the front center of the base operates the arrestment for beam and pans. Pans are nickel-plated, 8 cm. in diameter, and removable. Pillar and support are black lacquered and provided with plumb bob. Base is of finely finished hardwood and equipped with leveling screws. Capacity, 100 grams; sensitivity, 2 milligrams.

Each $18.00

42B. Balance, Laboratory, Magnalium, 100 gr. x 2 mg. Designed for chemical, technical and general laboratory use.

Made entirely of magnalium—a magnesium-aluminum alloy which offers the greatest resistance to all chemical fumes. This alloy has the additional advantage of being light and strong. The top edge of the beam is graduated and notched for use of rider. Support for beam is operated by lever-handle at front center of base. Magnalium base plate is equipped with leveling screws. Bearings and knife edges are of agate. Pans, removable, are 75 mm. in diameter. Capacity, 100 grams; sensitivity, 2 milligrams.

Each $27.50

45B. Balance, Chemical, Milvay, 200 gr. x 1 cg. All metal parts heavily nickeled and polished.

Beam 23 cm. long, removable pans 75 mm. diameter, mounted on 32x15x8 cm. base with drawer and milled head beam lift. The base of drawer is made of highly finished pearwood with edges trimmed in black. An exceptionally high grade balance at a low price. Capacity 200 grams, sensitivity 1 centigram.

Each $14.00

46B. Balances, General Laboratory, New Model. So-called pulp-balances.

Useful in the laboratory for a wide variety of weighings which do not require the accuracy obtainable with an analytical balance, such as: weighing large samples of materials, reagents for solutions, sugar for the Saccharimeter, pulp, etc. Also useful for calibrating glassware. The column is made of a single piece of aluminum, combining lightness and rigidity, and less likely to get out of order and more resistant to chemical fumes than the old cylindrical brass column construction. The planes are of agate, the knife edges of gilt steel and therefore corrosion proof.

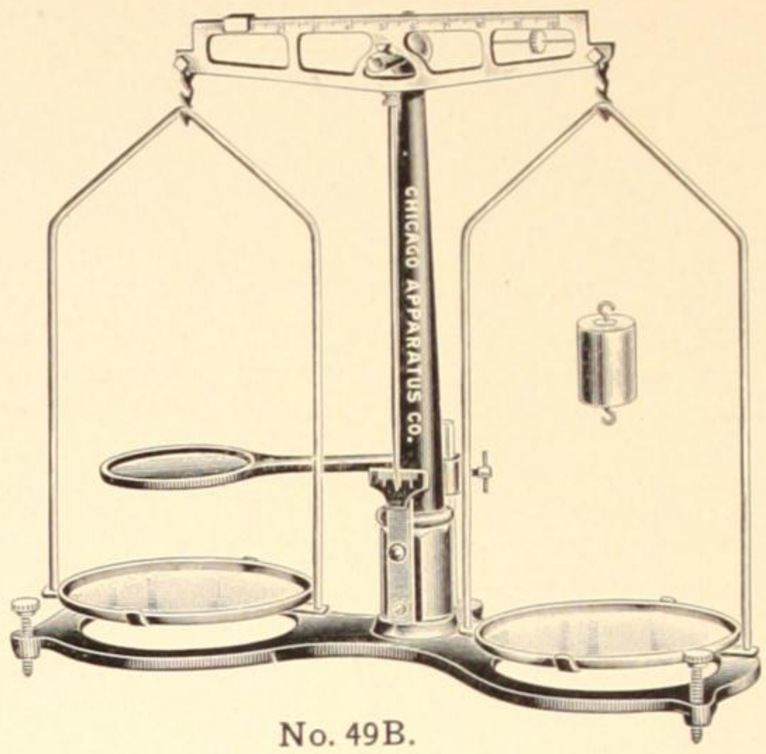
The lifting mechanism for the beam is the standard eccentric used on modern analytical balances and is operated by a large milled head. Pans are removable. Mounted on polished mahogany base with drawer; fitted with leveling screws and provided with circular spirit level.

Capacity, grams.....	150	300	600	1500
Sensitivity, mgr.	2	5	5	10
Diameter of pans, mm..	82	102	127	152
Length of beam, mm...	178	235	267	286
Each	$24.00	27.50	33.00	42.50

47B. Balances, General Laboratory, New Model. Same in every detail as No. 46B, but mounted on mahogany glass case with drawer and counterpoised front sliding door.

Capacity, grams.....	150	300	600	1500
Sensitivity	2	5	5	5
Diameter of pans, mm..	82	102	127	152
Length of beam, mm...	178	235	267	286
Each	$38.00	42.50	57.50	70.00

Milvay Improved Agate-Bearing Balance



No. 49B.

49B. Balance, General Laboratory, Milvay Improved Agate Bearing, 5000 gram x 1/20 gram. Recognized as the standard heavy-duty physics balance. More sensitive and convenient than the Harvard Trip Scale. Low in price—large size, features and advantages considered. Used in hundreds of the leading universities, colleges, high schools, and academies.

This instrument is a new and improved form of the balance originally designed for the Millikan and Gale Course. The original model has deservedly achieved a widespread popularity as the features which recommended its use in the physical laboratory promptly met with general approval on the part of progressive teachers. While we have manufactured and sold a large number of these balances, which have been highly complimented on account of their accuracy, superior workmanship, and neat appearance, it has been our conviction that in several particulars this type of balance was susceptible of improvement. In perfecting this balance we have not altered its general appearance, but have incorporated in it several modifications, the advantages of which are apparent. The improvements are as follows:

Agate Bearings—Agate grooves in both beam support and hangers have been substituted for the steel grooves formerly employed. This not only insures greater sensitivity at all loads, but many extra years of satisfactory service as well.

Rust-Proofed Knife-Edges—This added feature prevents corrosion and its attendant deterioration of sensitivity.

While we wish to call particular attention to the above improvements which we know will appeal to all science teachers, we desire also to emphasize the fact that in all the details of construction we have made decided improvements on existing forms of the instrument. Not an item which can contribute to durability, accuracy or appearance has been slighted, and we have no hesitation in making the claim that our Milvay Balance is by far the best on the market for the purpose for which it was designed.

Specifications

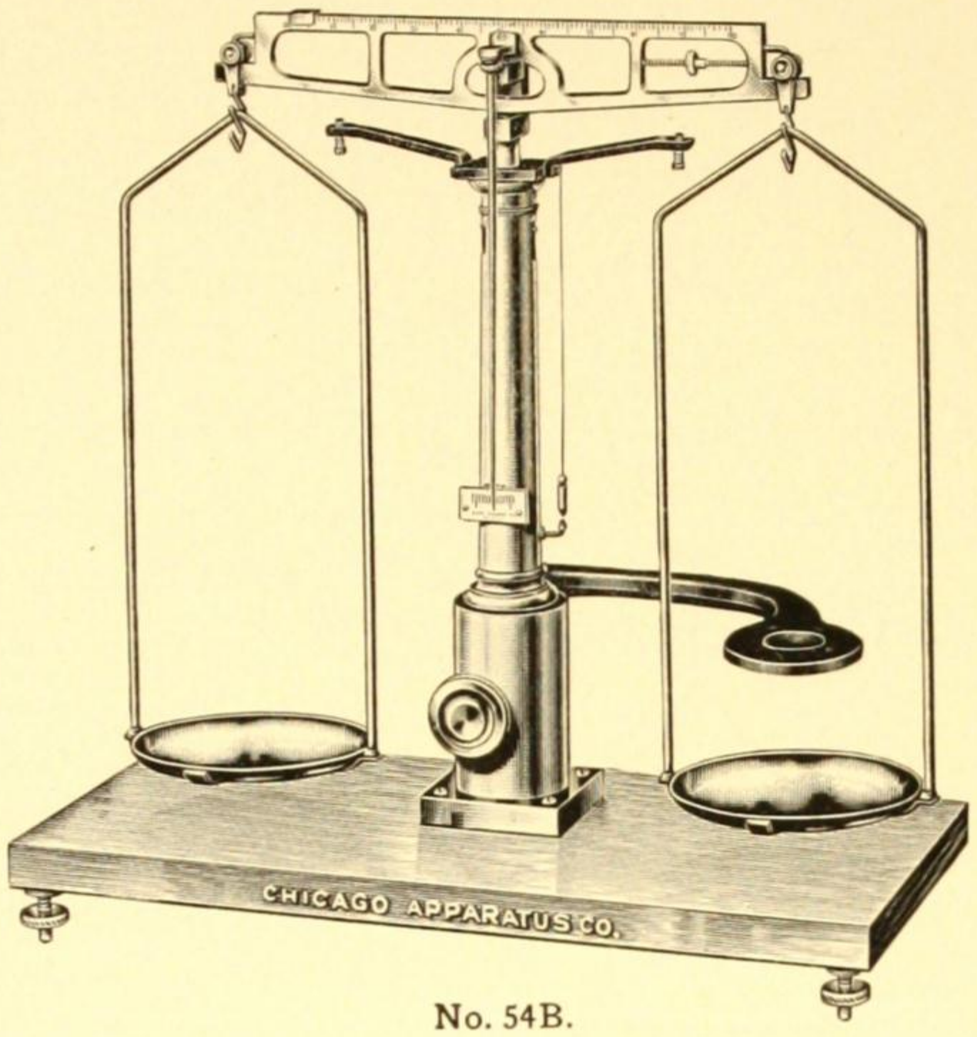
Capacity—5000 grams.
Sensitivity—Loads up to 5000 grams can be readily weighed to within 1/20th of a gram. For lighter loads the sensitivity is correspondingly greater.
Beam—Length, 26 cm.; open construction. A rider upon the beam indicates all amounts up to 10 grams by 1/10th gram divisions, making the use of small weights unnecessary.
Rider—Operates freely in a slot cut in the back of the beam and therefore cannot get lost.
Damping Device—A push button on the lower part of the index, when pressed, brings the index lightly against the pointer, effectively damping the swings of the balance.
Index Plate—Finely engraved on nickel-silver. Durable and wear-proof.
Knife Edges—High-grade rust-proofed steel, accurately adjusted.
Hangers—New design, free from friction and wear.
Pans—Aluminum, removable, polished; diameter 15 cm.
Platform—For supporting jar or tumbler of water in specific gravity work. This platform is adjustable as to height, may be readily swung out of the way or removed if desired.
Plumb Bob—For convenience in leveling. Placed back of pillar and therefore does not show in illustration.
Base and Pillar—Substantially constructed of japanned iron, nickel-plated leveling screws.
Height—40 centimeters.
With counterpoise, as illustrated.....**$16.50**

50B. Extra Pans for No. 49B. Of aluminum, polished, diameter 15 cm. **Each** **$0.50**

51B. Extra Stirrups for No. 49B. With agate bearings, to fit on knife edges at ends of beam. **Each** **$1.00**

52B. Extra Pan Supporting Bows For No. 49B. Of heavy wire, with cross blades at the bottom for the pans to rest upon. Without pans. **Each**.....**$1.00**

53B. Extra Counterpoises For No. 49B. With screw-cap covered cavity for accurate adjustment by the introduction of small lead shot. **Each**.....**$1.25**



No. 54B.

54B. Balance, Laboratory, Agate Bearing, 5000 grams x 50 mg. Has every important characteristic necessary to fit it for general work in chemical and physical laboratories. It is also a high-grade student's balance and is used as such in laboratories preferring a finer and more expensive balance than our No. 49B. The large capacity and rugged construction combined with high sensitiveness makes it more convenient and more useful than ordinary heavy duty types. Furthermore, this balance is so beautifully finished that it is bound to command the respect of every user and raise the equipment standard of even the best equipped laboratory. The finish not only provides the utmost beauty, but the utmost resistance to laboratory fumes as well.

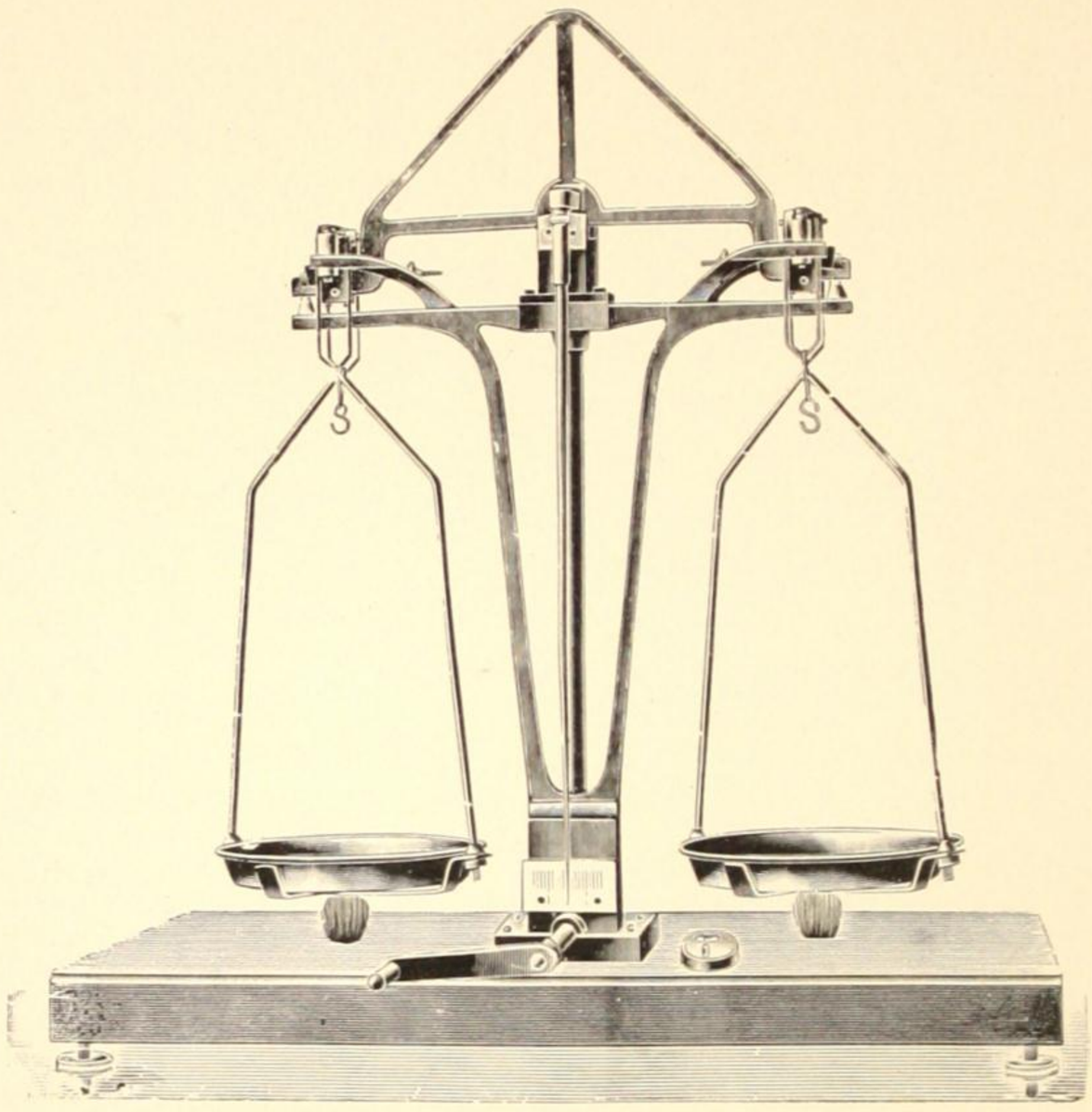
The heavy brass supporting column is mounted on a finely finished wooden base with leveling screws. To further assist in leveling, a small plumb bob is mounted alongside the pillar. The beam is raised and lowered by the large head at the front bottom of the column while the rest provided with adjustable screws serves to damp its oscillations. The beam is of the open construction type and is graduated to 10 grams in 1/10 gram divisions. Rider and hangers cannot become lost because they are of the non-removable type. The agate bearings in the beam support and end hangers provide the permanent high sensitiveness for which this balance is so well known. Adjustment of the pointer to the zero point of the index scale is quickly and easily accomplished by manipulation of the adjusting screw protectively mounted within the open work of the beam. For convenience in specific gravity work by the immersion method, an adjustable platform is provided. The pans are of aluminum and because of their large size will accommodate large objects impossible of being weighed on small pan balances. For this reason, this balance, in addition to ordinary uses, is valuable in weighing calorimeters and their contents; weighing the discs and rings used in inertia experiments; calibrating glassware; preparing solutions; weighing objects employed in specific gravity experiments; weighing masses used in impact experiments and for a wide variety of other general work in the laboratory and lecture room.

Specifications

Length of beam between knife edges	32 cm.
Length of graduated portion	25 cm.
Length of each 1/10 gram division	2.5 mm.
Height to top of beam	50 cm.
Diameter of pans	14 cm.
Width of bows	14.5 cm.
Height of bows	37 cm.
Size of base	23.5x49 cm.
Capacity	5000 grams
Sensitiveness with full load	50 mg.

Because of the fine workmanship, materials, appearance large capacity and high sensitiveness, this balance represents unusual value at our low price **$37.50**

Lecture Table Balance



No. 57B.

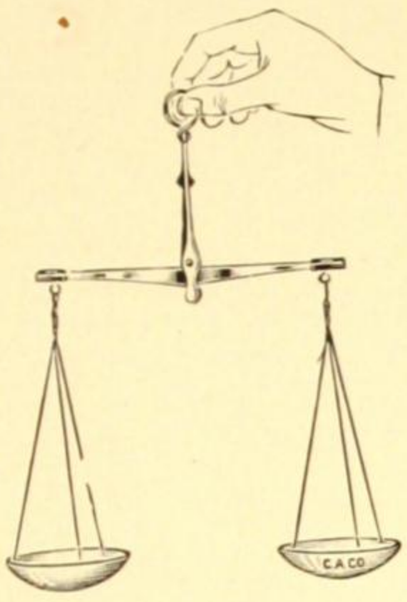
57B. Balance, Lecture Table, 3 kilo x 20 mg. Large capacity and high sensitivity make this balance ideal for lecture table demonstration.

Of such sturdy construction that loads up to 6 kilos, when weighed occasionally, can do no harm.

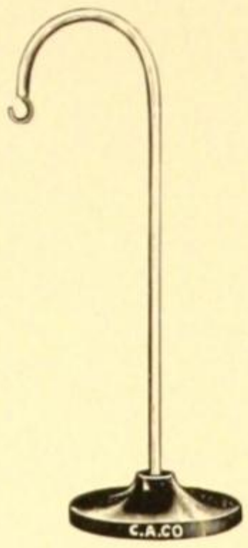
The beam is of aluminum and of the short arm type. This provides high sensitivity and a short period of oscillation which facilitates rapid weighing. Besides this short arm balance occupies much less room than similar balances with long arms. All bearings are of Agate.

The pillar is of iron finely finished in black enamel. The arrestment of the beam and hangers is effected by a lever, an eccentric and a roll, while construction provides absolutely smooth action free from all jarring. The knife edges may be freed from contact when balance is not in use. The pan arrests are of the brush type.

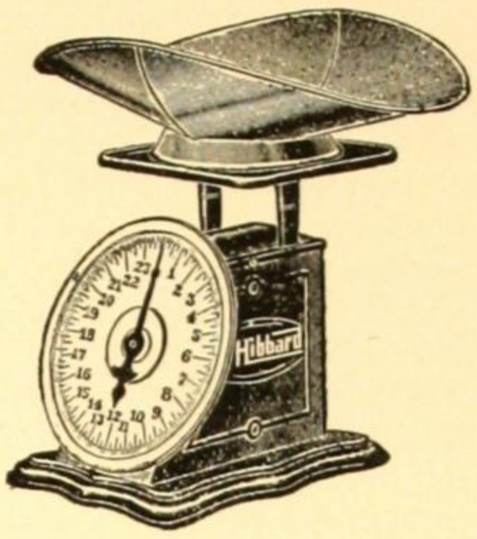
Mounted on finely finished base and provided with cross level and leveling screws. Capacity, 3 kilos; sensitivity, 20 mg.; diameter of pans, 19 cm. . . **$60.00**



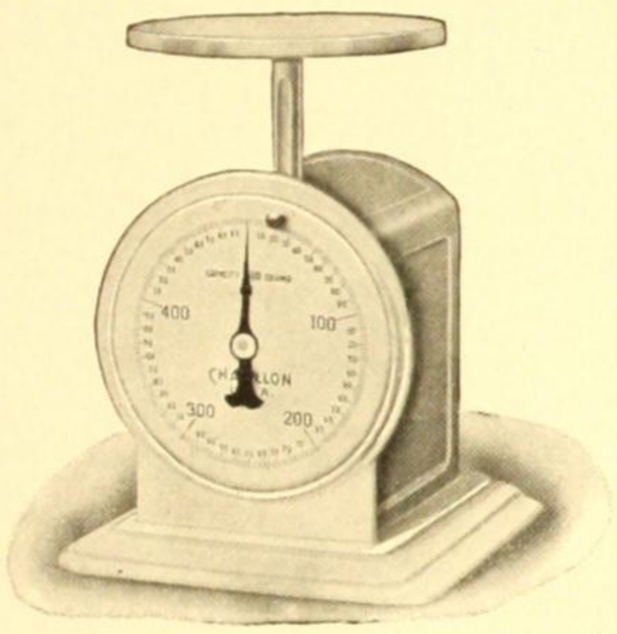
Nos. 64B-66B.



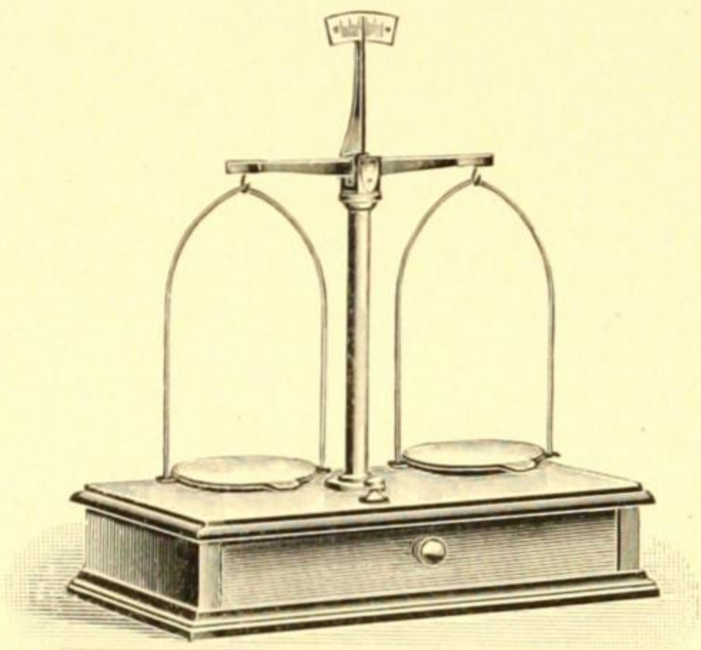
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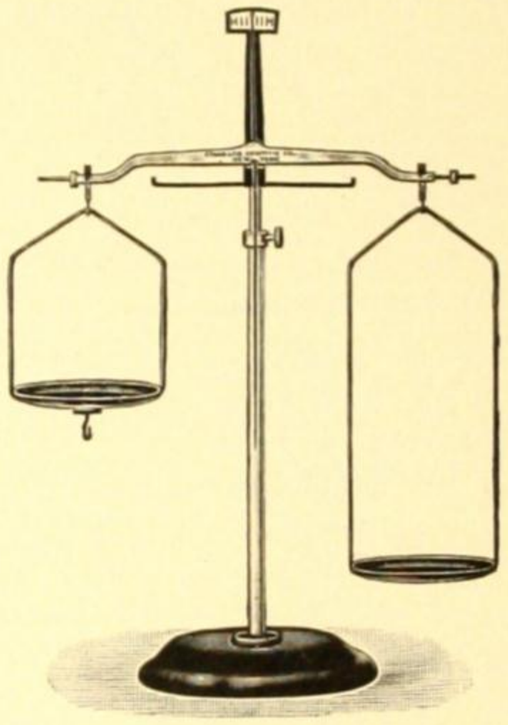
No. 71B.



No. 72B.



No. 74B.



No. 79B.

64B. **Balance, Horn Pan. 50 Gram x 1 Cg.** Gold lacquered brass beam 15 cm. long; round horn pans 6.5 cm. diameter, suspended from green silk cords; capacity 50 grams; sensitivity 1 centigram. A very desirable balance on account of its low price, for student's individual use **$2.70**

66B. **Balance, Horn Pan. 100 Gram x 1 Cg.** Same as No. 64B, but with beam 19 cm. long and pans 8 cm. in diameter **$3.75**

69B. **Support for Horn Pan Balances.** Curved, nickel-plated support rod with suspension hook; round black enameled iron base, 12.5 cm. in diameter. Can also be used to advantage in magnetism and electrostatic experiments for suspending bar magnets and friction rods. Height, 42 cm..... **$1.50**

71B. **Balance, Automatic, Family Scale, 24 lbs. x 1 oz.** Useful in parallel force, Prony brake and other experiments. Direct reading, slanting white enameled dial, zero corrector beneath platform, stamped platform. Dial is graduated to 24 pounds in 1 oz. division **$3.25**

71Ba. **Balance, Automatic, Metric.** Same as No. 71B, but with dial graduated to 10 kilos in 50 gram divisions **$3.25**

72B. **Balance, Automatic, Rotary Dial. 500 Gram x 2 Gram.** This scale is so constructed that the indicator can readily be returned to "0" after a beaker or other container has been placed on the platform. Thus the pointer will indicate on the dial directly the weight of the material placed in the container, thereby eliminating all tare weight calculations and the errors which might arise from this source. Balance is finished in white enamel. Dial is silver finish on which the graduations and numerals appear in black. Dial is graduated to 500 grams in 2 gram divisions. **$10.00**

74B. **Balance, Prescription. 50 Grams x 1 Cg.** Mounted on hardwood box with one drawer. All metal parts are heavily nickel-plated and may easily be taken apart and packed into the drawer. Beam, 15 cm. long, lifted by lever in base of pillar; removable pans 7.5 cm. in diameter; capacity 50 grams; sensitivity 1 cg. **$8.00**

79B. **Balance, Specific Gravity. 200 Grams x 1 Cg.** While primarily designed for specific gravity work, this balance may also be used for all other weighings within the limits of its capacity and sensitivity. Gold lacquered brass beam 22.5 cm. long; brass pans 9.2 cm. in diameter, suspended from metal bows; accurately adjusted, prismatic steel knife edges; heavy black enameled iron base. Beam and beam arrest are so mounted on a telescoping rod that the distance under the short pan may be varied from 10 to 30 cm. above the table top. The pans being suspended from metal bows are more easily accessible than those suspended from chains as in the older models. Capacity 200 grams; sensitivity 1 centigram **$9.00**

Milvay Precision Jolly Balance

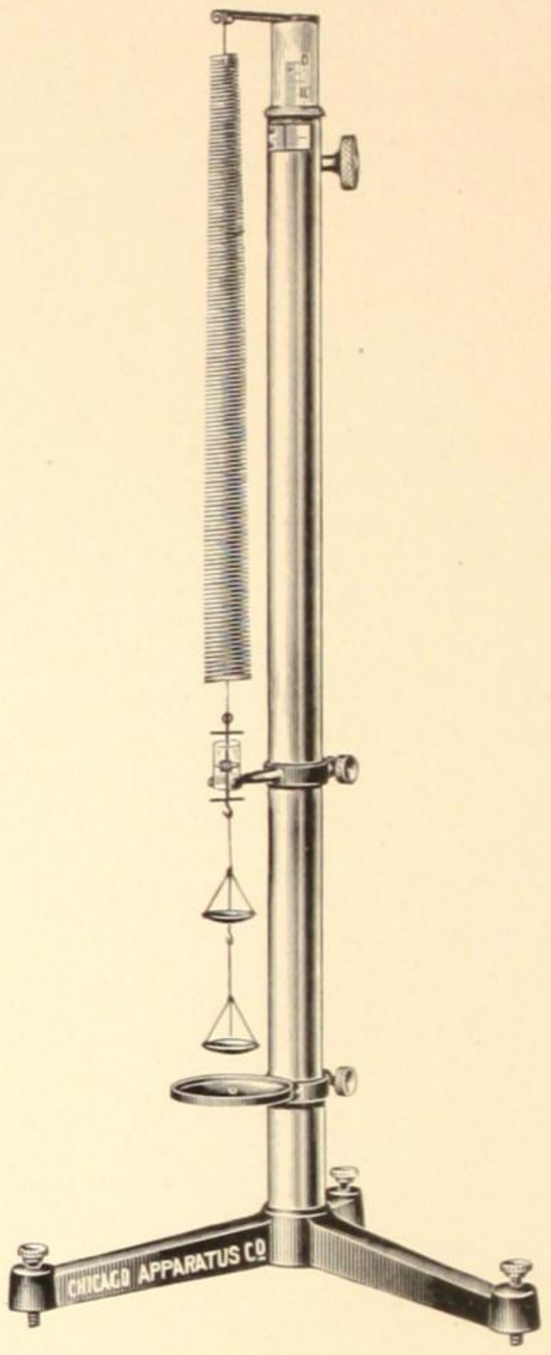
80B. Balance, Specific Gravity, Jolly, Milvay Precision Type. With vernier reading attachment. A standard rack and pinion, similar to that employed in compound microscopes, moves the inner tube—which is graduated for 50 cm. in millimeters—vertically throughout its entire length. This raising and lowering mechanism, controlled by a large "milled head" near the upper end of the outer supporting tube, provides a positiveness and smoothness of action equal to that found in the finest microscopes. It provides that nicety of adjustment which makes certain the greatest possible precision in Jolly balance work.

The lower end of the spring carries a special index, consisting of a short black metal cylinder with three white lines around its circumference and spaced about 1 mm. apart. This index moves freely in a small glass tube with a single black line etched about its circumference and provides a simple means for accurately adjusting the position of the index without parallax. The cross-arms confine the up and down motion of the index and spring to within narrow limits, preventing the violent movements which otherwise spill weights and detach pans.

Furthermore, the absence of violent spring movements makes the placing and removing of weights and specimens far easier and more convenient than in Jolly balances without this "check" feature. The vernier permits determination of the spring elongations to within 1/10 mm.

Because of the exclusive features possessed by this balance it offers a far wider range of usefulness than the ordinary type. The following are just some of the many experiments in which it can be used to good advantage: Specific gravity determinations of various kinds. Pendulum experiments involving accurate determinations of length. Hooke's law and the calibration of a spring. Precision weighing with a spiral spring balance. Mass determination by the longitudinal vibration method. Moment of inertia by torsional vibrations. Surface tension by ring and drop method. Distribution of magnetism in a magnet. Densities of objects by measurements of their dimensions and weight, etc.

The balance is mounted on a gloss-enameled, heavy iron tripod provided with three nickel-plated leveling screws. The tumbler platform is of brass, and therefore rust proof, finished in dead-black and easily adjustable as to height. The index arm is also of dead-black finished brass and easily adjustable as to height. The inner and outer tubes are of brass with finest nickel finish. The light spring is accurate and sensitive to about 2 mg. and has a range of about 10 grams. The heavy spring is accurate and sensitive to about 10 mg. and has a range of about 100 grams. Complete with light and heavy springs, aluminum and glass pans, adjustable tumbler platform, and special "check-type" index.....**$50.00**



No. 80B.

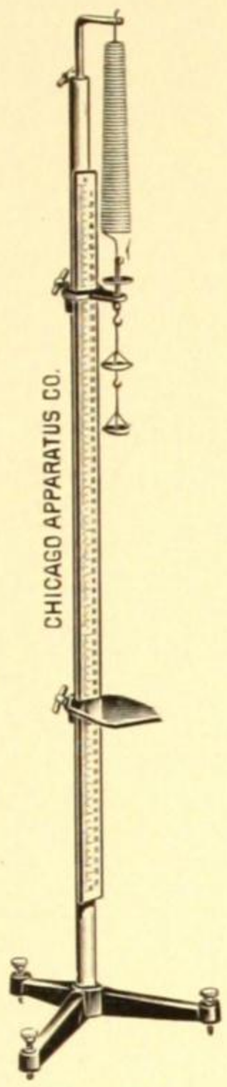
81B. Index with Glass Tubes for No. 80B. For replacement **$1.50**

82B. Glass Tube for No. 80. For replacement..**$0.40**

83B. Spring, Heavy, for No. 80B. For replacement. Elongation per gram, about 1.2 cm.....**$1.00**

84B. Spring, Light, for No. 80B. For replacement. Elongation per gram, about 5 cm.....**$1.00**

84Ba. Platform with Slow-Motion Screw. For slowly lowering the beaker of water employed in surface tension work, as outlined in Exp. 5, "Physical Measurements, Part 1, Heat, Mechanics and Properties of Matter" by Minor (1929). In use this platform is attached to the main column of No. 80B Jolly Balance in place of the ordinary sliding platform with which the latter is equipped.....**$4.00**



No. 85B.

85B. Balance, Specific Gravity, Jolly. Offers the same advantages found only in the more expensive models, yet because of quantity production, costs no more than a plain Jolly without Spring Check or Index Disk. The check limits the motion of the spring to within narrow limits, preventing the violent movements which spill weights and detach pans in the old models. It makes manipulation easier, more convenient and more rapid. The index disk with the polished nickel-silver scale directly back of it makes possible extremely accurate readings. Errors of parallax are impossible. The scale, accurately etched on nickel-silver, is non-corrosive and non-breakable. It is 70 cm. long and graduated in mm. The upright is a nickel-plated hollow brass tube. This construction eliminates top-heaviness. The spring support is adjustable through a distance of 25 cm. and may be clamped at any desired position. The tumbler platform is of brass and therefore will not corrode. The base is heavy and provided with three leveling screws. Complete with two aluminum pans and one No. 99B Spring. Compare this balance with others selling at twice the price.....**$9.00**

Extra Parts for Jolly Balances

These are standard and may be used with any Jolly Balance regardless of make or model.

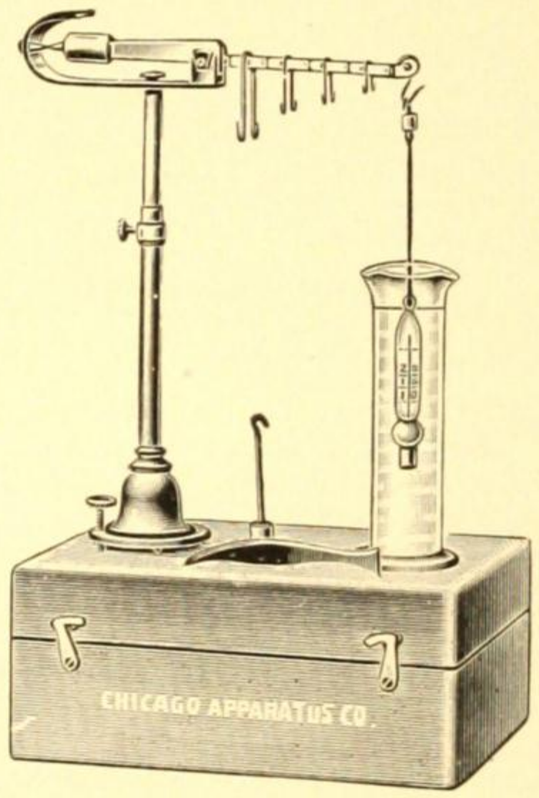
89B. Scale Pan, Aluminum, Lower. Diameter 38 mm., with wires and loop for suspension.....**$0.25**

94B. Scale Pan, Aluminum, Upper. Diameter 38 mm., with wires and loop for suspension and hook underneath for holding a lower pan.....**$0.30**

96B. Scale Pan, Glass, Lower. Diameter 38 mm., with platinum wires and loop for suspension...**$1.00**

99B. Spring, Heavy. Steel, conical form, elongation per gram about 1.2 cm.....**$0.50**

104B. Spring, Light. Steel, conical form, elongation per gram about 5 cm.....**$0.50**



No. 105B.

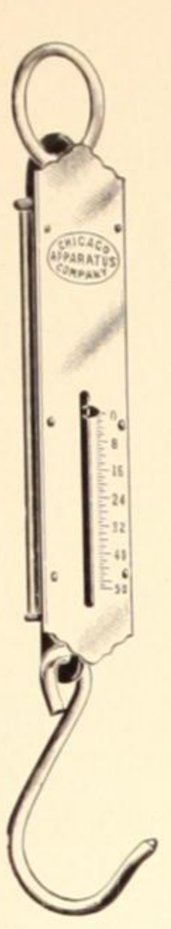
105B. Balance, Specific Gravity, Westphal. For rapid determination of specific gravity of liquids up to the fourth decimal place. The adjustable pillar and all other parts can be packed away in the box. Complete with Reimann's thermometer, counterpoise, set of eight riders and jar.....**$19.00**

106B. Reimann's Thermometer of No. 105B, reading from 10° to 30° C., with displacement of 5 cc...**$3.50**

107B. Riders, Set of Eight, of No. 105B..... **2.50**

108B. Glass Jar, of No. 105B..... **.35**

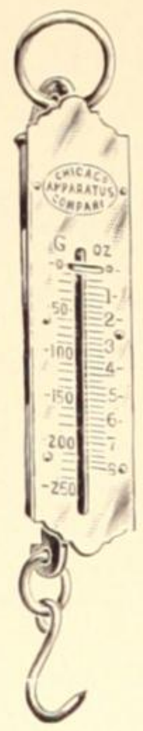
Spring Balances



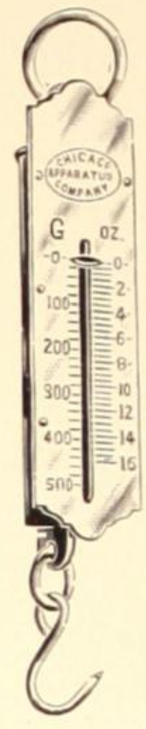
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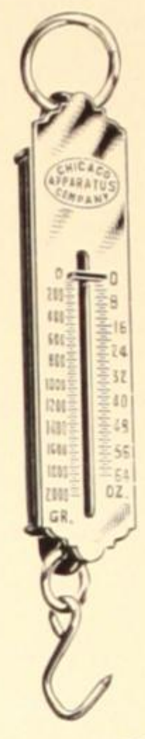
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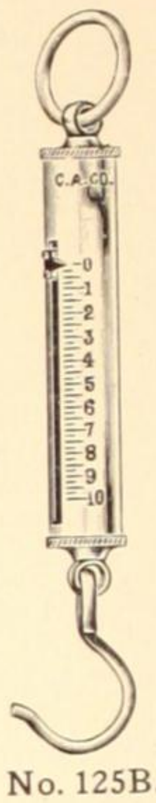
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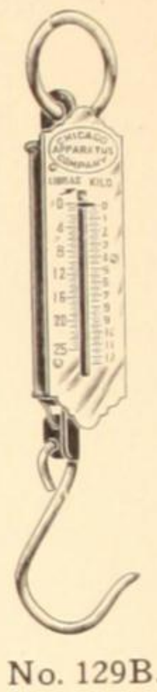
No. 119B.



No. 124B.



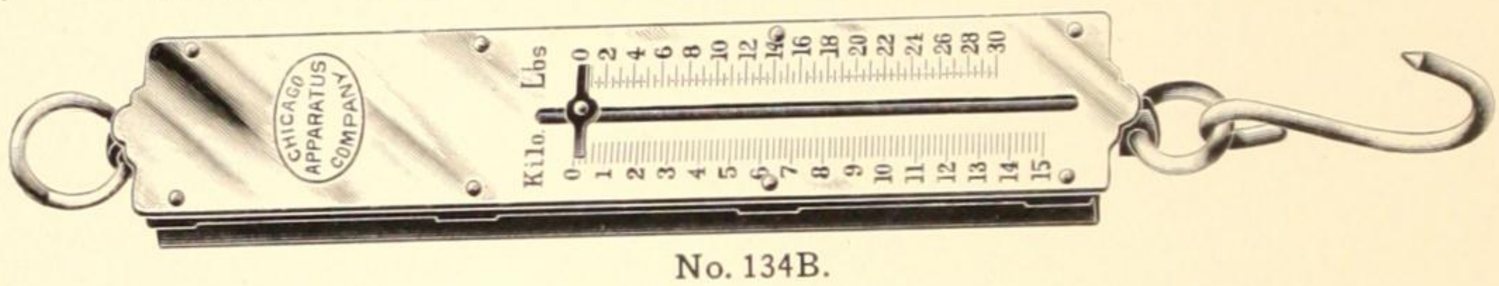
No. 125B.



No. 129B.



No. 225R.



No. 134B.

109B. Balance, Spring, 50 lb. Nickel-plated dial 15.5 cm. long, round back, reads to 50 lbs. in 1-lb. divisions **$0.80**

110B. Balance, Spring, 25 lb. Dial 12 cm. long, round back, reads to 25 lbs. in 8 oz. divisions..... **$0.30**

112B. Balance, Spring, 15 lb. Cylindrical pocket form; free from zero error; overall length, 6 inches. Reads to 15 lbs. in 4-oz. divisions..... **$0.65**

114B. Balance, Spring, 250 gr. and 8 oz. Nickel-plated dial 12 cm. long, flat back and broad pointer for either perpendicular or horizontal readings. Reads to 250 grams in 10 gr. divisions and 8 oz. in ¼ oz. divisions **$1.25**

119B. Balance, Spring, 500 gr. and 16 oz. Nickel-plated dial 12 cm. long, flat back and sharp pointer. Reads to 500 grams in 20 gram divisions and 16 ounces in ½ ounce divisions..... **$2.00**

121B. Balance, Spring, 500 gr. and 18 oz. Nickel-plated dial 26 cm. long, flat back and sharp pointer. Reads to 500 grams in 10 gram divisions and 18 ounces in 1/5 oz. divisions..... **$3.50**

124B. Balance, Spring, 2000 gram and 64 ounce. Nickel-plated dial 12 cm. long, flat back and broad pointer for either horizontal or vertical readings. Reads to 2000 grams in 25 gr. divisions and 64 ounces in 1 oz. divisions..... **$0.75**

125B. Balance, Spring, Laboratory Dynamometer, 10 lb. Cylindrical form, especially suitable for experiments in practical physics. Capacity 10 lbs. by ¼ lb. divisions. 4⅜ in. long..... **$2.75**

126B. Balance, Spring, Laboratory Dynamometer, 20 lb. Same as No. 125B, but 20 lbs. by ¼ lb. divisions and 8 in. long..... **$3.75**

127B. Balance, Spring, Laboratory Dynamometer, 30 lb. Same as No. 125B, but 30 lbs. by ½ lb. divisions and 4⅜ in. long..... **$2.75**

128B. Balance, Spring, Laboratory Dynamometer, 60 lb. Same as No. 125B, but 60 lbs. by ½ lb. divisions and 9½ in. long..... **$7.50**

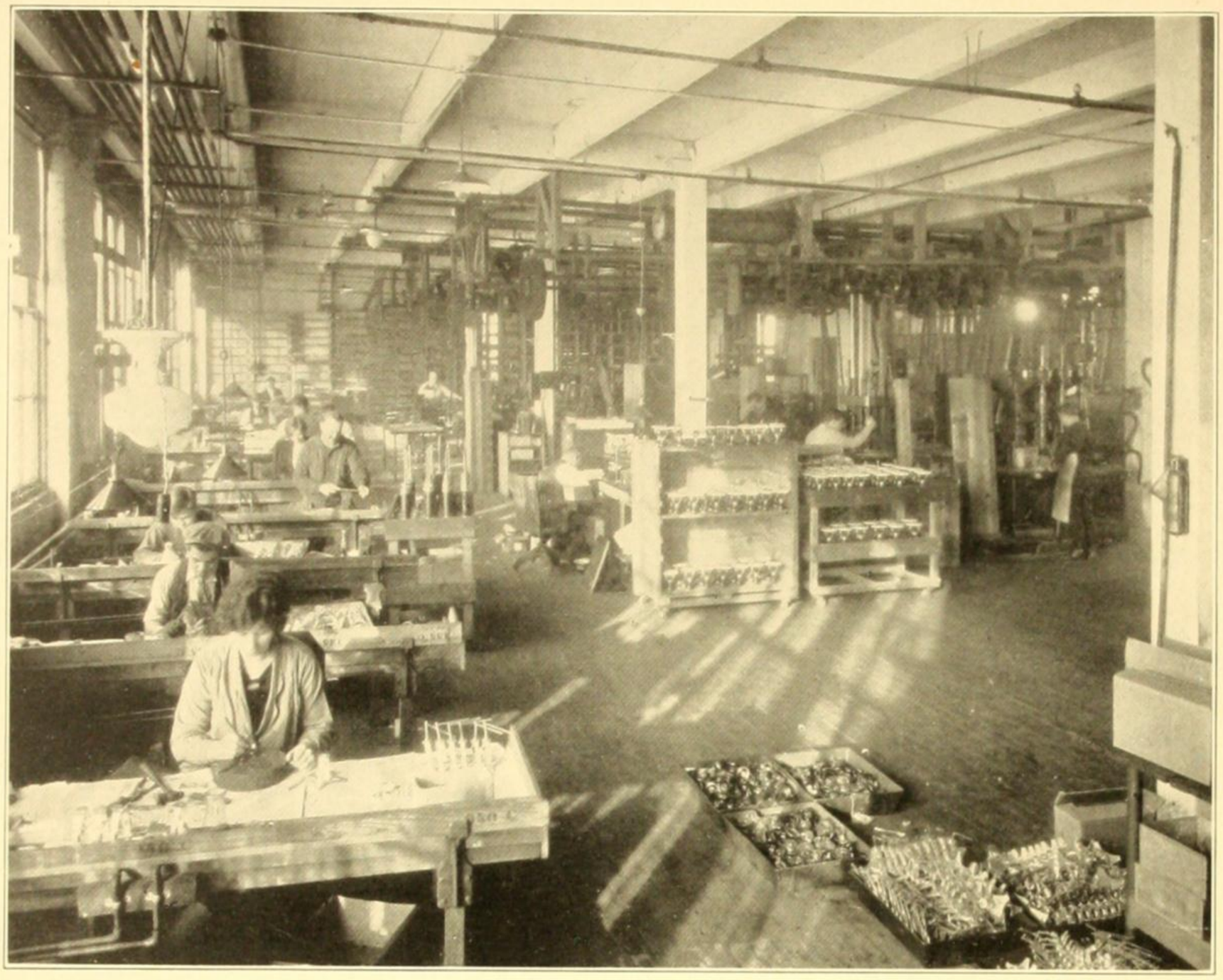
128Ba. Balance, Spring, Laboratory Dynamometer, 6 Kilos. Cylindrical form like No. 125B. Capacity 6 kilos or 6000 grams by 50 gram divisions. Total length, 24 cm..... **$7.50**

129B. Balance, Spring, 12 Kilos and 25 lbs. Lacquered brass dial 9.5 cm. long, round back. Reads to 12 kilograms in ¼ kilo divisions and 25 lbs. in ¼ lb. divisions..... **$0.40**

134B. Balance, Spring, 15 Kilos and 30 lbs. Nickel-plated dial 32.5 cm. long, flat back and broad pointer for perpendicular and horizontal readings. Reads to 15 kilograms in 100 gram divisions, 30 lbs. in ¼ lb. divisions..... **$3.30**

136B. Balance, Spring, 15 Kilos and 30 lbs. Especially designed for use in experiments on tensile strength, the indicator remaining at the breaking point, instead of returning to zero as in ordinary spring scales. Reads to 15 kilograms in 100 gram divisions and 30 lbs. in ¼ lb. divisions. In flat back iron case with sliding index recorder, and nickel-plated dial 30 cm. long **$11.00**

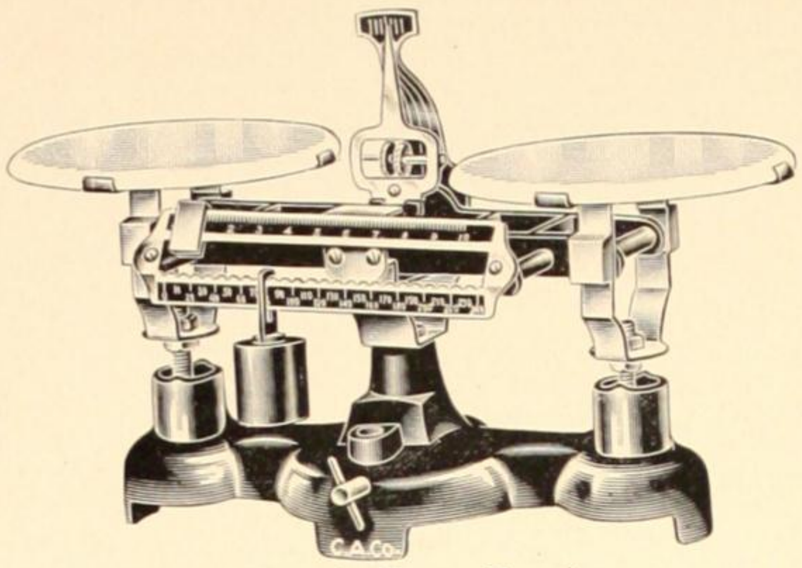
255R. Balance, Flotation, Dull's. A compression balance for measuring the buoyant force (about 175 grams) of a wooden block like our No. 279R, as outlined in Dull's "Laboratory Exercises in Physics," Exp. 8, (1929). Since the buoyant force of a floating block cannot cause spring compression, or pointer movement, until the buoyant or upward force exceeds the weight or downward gravitational pull on the sliding rod, the weight of the latter is adjusted to correspond exactly to the lowest graduation on the balance, namely 50 grams. In this way the "weight-of-sliding" rod error—about 50 grams—unavoidable in flotation balances graduated down to zero, is eliminated. Thus, every indication on this new balance, within its range, 50 to 250 grams, is a true measure of the upward force against its lower four points. Further, the longer scale and finer divisions —5 grams—permit closer readings. Heavy brass, nickel-plated cylindrical body, with aluminum sliding rod. Overall length, 24 cm. **$4.75**



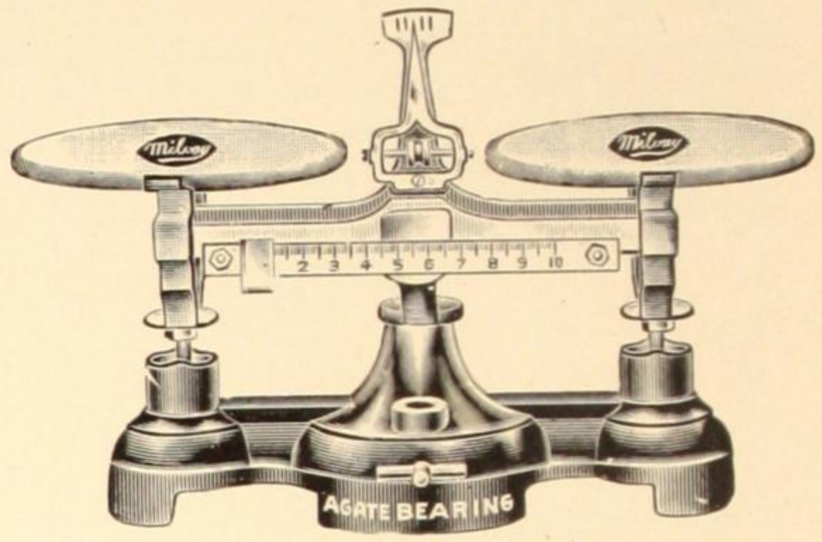
Manufacturing

Special machinery, elaborate tools, complicated dies, skilled workmen, and competent supervision are responsible for the high mechanical standards in *Milvay* Scientific Instruments. In addition, our plant provides exceptional manufacturing facilities—pleasant working conditions and ample daylight—resulting in an even higher standard of precision and workmanship.

Milvay Agate-Bearing Trip Scales



(Double-Beam Type)
No. 166B.



(Single-Beam Type)
No. 169B.

166B. Milvay Double-Beam Trip Scale, 250 Gram Side Beam Capacity. This scale was originated and is exclusively manufactured by the Chicago Apparatus Company. Its wide popularity is due to the following ten advantages:

1. Weighs to 250 grams without weights. Accurate to $\frac{1}{10}$ of a gram up to 2,000 grams and slightly less sensitive for loads above 2,000 grams. Old style single beam trip scale requires extra weights over 10 grams.

2. Over twice usual capacity. Takes anything up to 5,000 grams. Capacity of practically all single beam trip scales is 2,000 grams.

3. Weighs one-third faster. Perfect balance reduces oscillation period one-third. No weights to handle. Speeds work.

4. More accurate than weight scales. Miscellaneous, doubtful small weights unnecessary.

5. A net and tare milk scale. Capacity of side beam more than needed to offset tare weight of test bottles and samples—impossible with single beam trip scales.

6. Absence of weights avoids mistakes. All weights up to 250 grams indicated by position of two rider weights on double beam. Single beam requires addition of loose weights to 10-gram beam weight.

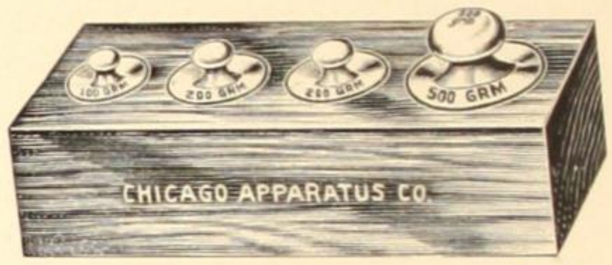
7. Fume and corrosion-proof. Minimum iron used in construction. Only important iron part is base which is perfectly protected by two coats of black non-chip enamel. All other parts are fume and corrosion-proof. Even knife edges, which rest on six large agate shelves, are proof against fume and corrosion to preserve permanently original sensitivity. Exclusive new mounting for agates.

8. Elevating socket for gravity work. Can be clamped to 13 mm. rod for elevating above table top in specific gravity work. Practically every specific gravity experiment can be made on 250 gram beam.

9. Perfect mechanically. Scientifically correct construction, adjustment, accurate and rigid, make possible weighings to 5,000 grams without variation. We know of no other scale of such high standard.

10. Easy-reading. Nickel-silver graduations on dead black background stand out clearly.....**$12.00**

265B. Weights, Metric, Medium Grade. This set has been especially designed for use with Double-Beam Trip Scales having a total beam capacity of 100 grams or more. When so used, it extends the weighing range 1000 grams beyond the beam range of the balance. Thus, when used with our No. 166B Double-Beam Balance this set will take care of all weighings from $\frac{1}{10}$ to 1250 grams. One each 100, 200, 200, and 500 gram solid brass weights, of a grade suitable for all ordinary laboratory weighings, in fine wood block **$4.00**

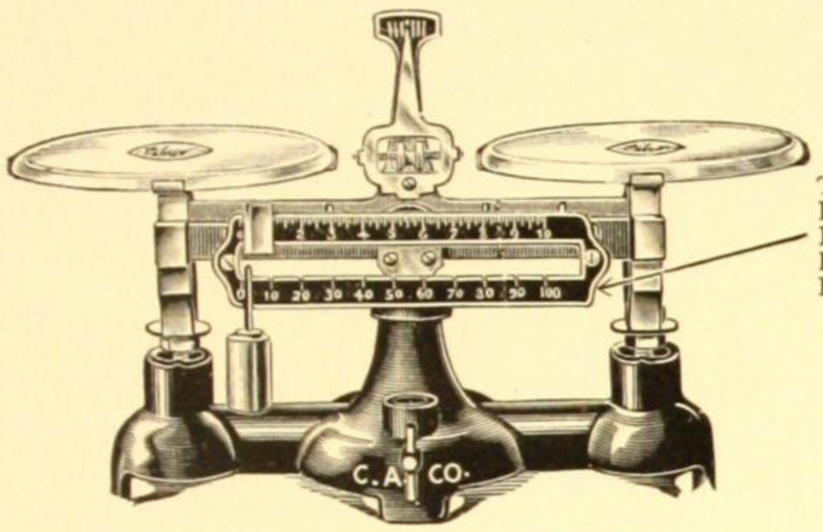


No. 265B.

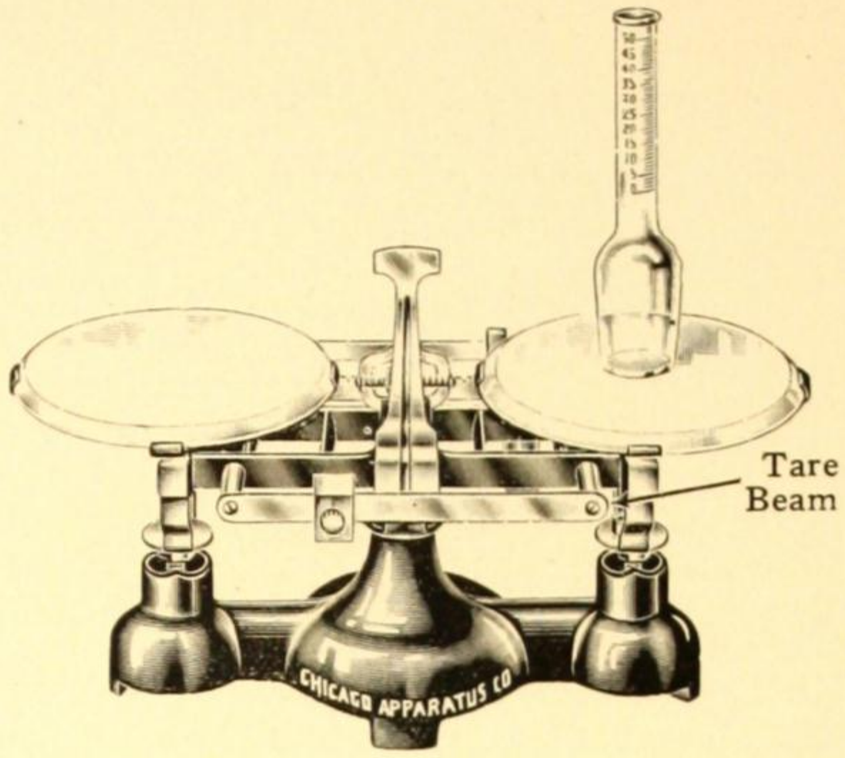
169B. Balance, Trip, Milvay Single-Beam Type. Agate Bearing, 5000 Grams x 1/10th Gram. Harvard design. In the design and construction of this scale two important things have been accomplished.

First—A higher degree of accuracy. Second—Greater durability.

The former has been accomplished by forming the metal parts by special tools and machinery, and the mechanical accuracy thus attained make correct weighings possible without variation, regardless of whether masses are placed at center or edge of pans. The latter has been accomplished by the elimination of iron, except in the base, which is perfectly protected by two coats of black non-chip enamel. All other parts are fume and corrosion proof. Even knife edges, which rest on six large agate bearings, are proof against fume and corrosion to preserve permanently original sensitivity. In the base is an elevating socket for specific gravity work. It can be clamped to a 13 mm. rod, as illustrated under No. 174B. Perfect balance design reduces the oscillation period one-third. The Milvay, therefore weighs one-third faster. No small weights under 10 grams are required with this scale as the sliding rider on the graduated beam indicates all weights up to 10 grams in $\frac{1}{10}$th gram divisions. The pans are white, round, flat, porcelain plates 14 cm. in diameter. The beam adjusting screw is conveniently located in the pointer opening. Directly below the knife edges of each scale pan is a hook, from which to suspend objects underneath, as required in specific gravity work. Overall dimensions: 36x19x15 cm.; capacity 5000 grams; sensitivity $\frac{1}{10}$th gram.....**$10.00**



(Double-Beam Type)
No. 170B.



No. 171B. (Back View).

170B. Balance, Trip, Milvay Double-Beam Type, Agate Bearing, 5000 Grams x 1/10th Gram. Same as No. 166B, but with lower beam graduated to 100 gr. in 10 gr. divisions, and the upper beam to 10 gr. in $\frac{1}{10}$th gr. divisions, making the total beam capacity 110 grams. Thus, all weighings below 110 grams, accurate to $\frac{1}{10}$th gr., can be made on this balance without the use of weights. Maximum capacity, 5000 grams **$12.00**

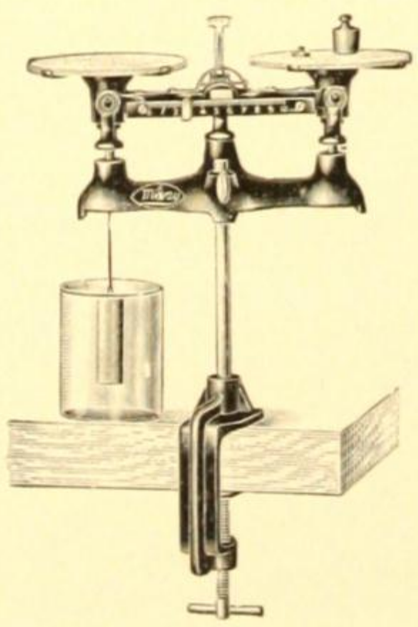
171B. Balance, Trip, Milvay Three-in-One. Agate Bearing, 5000 Grams x 1/10 Gram. Combines three scales in one—Babcock Test Scale, Double Beam Trip Scale, Solution and Dispensing Scale. Same as our No. 166B Milvay Double Beam Trip Scale with two beams in front, permitting weighings up to 250 grams without extra weights. In the back is a tare beam for counterpoising empty milk and cream test bottles, or other containers weighing less than 50 grams. This scale eliminates the use of 9 and 18 gram weights employed with other Babcock test scales—weights which on account of their small size easily get lost. In addition to its great convenience in milk and cream test work it will do all that the Double Beam Trip Scale, described above, will do—weigh up to 250 grams without extra weights. For this reason it is also valuable as a Solution and Dispensing Scale and when so used no extra small weights are required. Fume-proof, corrosion-proof, and up to the same high standard of accuracy as all other Milvay trip scales. Has hooks underneath each pan, and elevating socket in base for convenience in specific gravity work. (See No. 174B.) The pans are round, flat, white porcelain plates 14 cm. in diameter. Total capacity 5000 grams; sensitivity $\frac{1}{10}$th gram **$15.00**

172B. Extra Porcelain Plates for Nos. 166B, 169B. 170B, and 171B, for replacement. **Per pair** **$1.00**

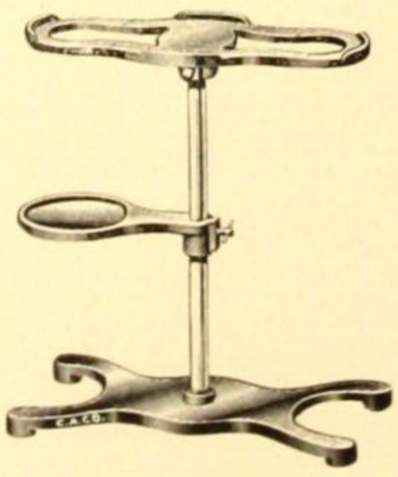
173B. Extra Agate Bearings for Nos. 166B, 169B. 170B and 171B. For replacement, **Each** **$0.50**

174B. Specific Gravity Support, Milvay. For Elevating Nos. 166B, 169B, 170B, and 171B Trip Scales above table top, as required in specific gravity work. Black enameled iron table clamp, provided with a 20 cm. x 13 mm. nickel-plated support rod. The clamp is designed to fit any table top 10 cm. thick or less, and being provided with a large flange, about 6½x8½ cm., will not injure or mar the table top **$1.50**

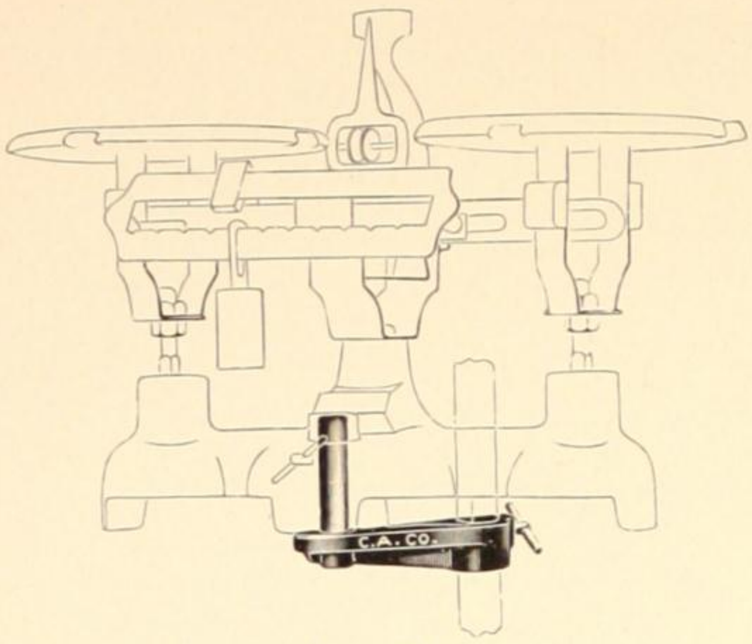
176B. Trip Scale Support, Milvay. For elevating trip scales, like our Nos. 166B, 169B, 170B and 171B, as required in specific gravity work. The base purposely has been made extra large, it covers an area of 28x14.5 cm., to provide ample stability. The retaining edge around the top prevents the balance from shifting or sliding off. The center rod is 30 cm. long and the tumbler platform can be clamped at any point on this rod. Iron parts are black enameled; screws and rod, nickel-plated **$3.50**



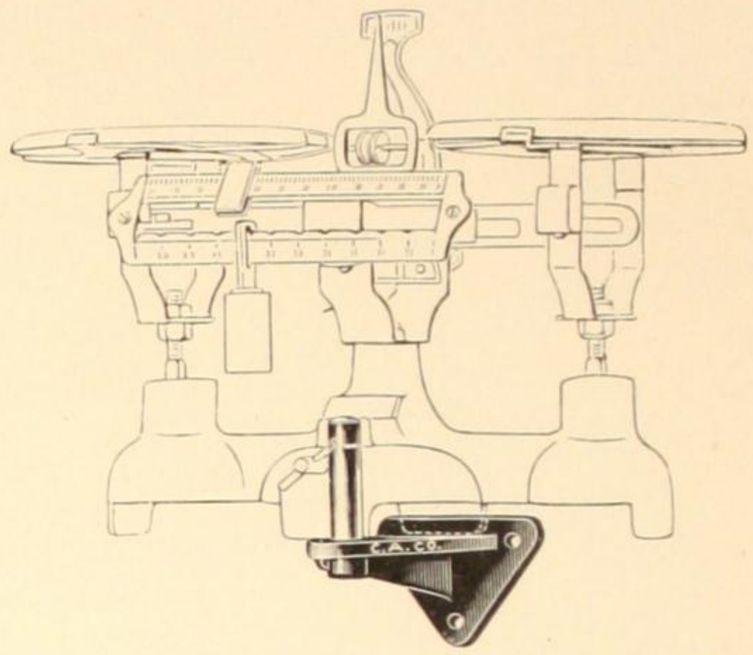
No. 174B.



No. 176B.



No. 177B.

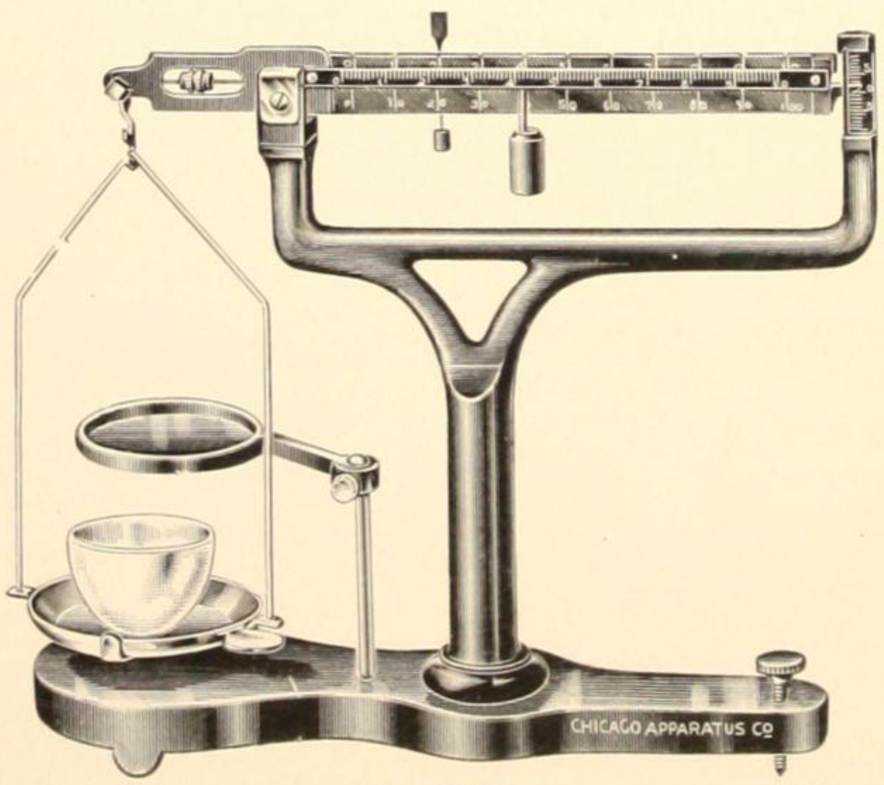


No. 178B.

177B. Trip Scale Rod Bracket, Milvay. In response to numerous requests we have developed a simple, yet effective means for supporting trip scales at an elevation on standard 19 mm. diameter vertical support rods with which most laboratory tables are equipped. In the physical laboratory this new bracket will be found useful in elevating the trip scales for specific gravity and other work. In chemistry and other laboratories it will permit the clamping of trip scales at shoulder height, at the end of the tables. When so used it permits weighings to be made conveniently while standing. It makes each scale available to a group of students. It conserves table space. It provides a permanent place for each scale, thereby preventing the wear and tear that results when scales are constantly moved about. Further, it does not limit the height to which the scale may be elevated as all other scale supports do. It is small, compact and therefore inconspicuous. Of iron, black-enameled to fit 19 mm. diameter round rods and to support any trip scale with socket in base, like our Nos. 166B, 169B, 170B and 171B.....**$0.75**

178B. Trip Scale Wall Bracket, Milvay. Same as No. 177B, but designed for attaching to a wall or board, by means of three screws, instead of to a support rod. With screws.....**$0.75**

Milvay Triple Beam Agate-Bearing Balance



No. 184B.

184B. Balance, Triple Beam, Milvay, Agate Bearing. Offers a number of improvements over older models: 1. The bearings are high-grade agates, insuring a permanent and higher sensitivity. 2. The adjusting screw is placed in an opening in the beam where it is out of harm's way instead of exposed on the end of the beam. 3. The beams are made of nickel-silver and therefore proof against laboratory fumes. 4. The graduations and figures are silver-white against a black background and therefore more legible. 5. The weights are non-removable. 6. Corrodible parts eliminated; the base and pillar are of cast-iron protected by baked-on black japan; the beams are nickel-silver and therefore non-corrodible; the knife edges are rust-proofed. Capacity of middle beam, 100 by 10-gram divisions; back beam 10 by 1-gram divisions; front beam 100 by 1 centigram divisions; total capacity 111 grams; sensitiveness 1 centigram. Diameter of pan, 9.5 cm. A platform for holding a vessel of water and which can be quickly raised, lowered or swung out of the way will be found very convenient in specific gravity work. For rapid weighing, constant and high sensitiveness, accuracy, freedom from loss and breakage of weights, the Milvay Triple Beam Agate Bearing Balance is unequaled....**$17.50**

185B. Extra Weight. For increasing capacity of No. 184B to 201 grams. In use this weight is placed on the 100 gram notch of the middle beam.....**$1.00**

185Ba. Extra Stirrup for No. 184B. For replacement, to fit over the end knife edge of the beam.....**$0.35**

Balance Accessories



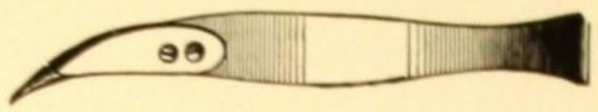
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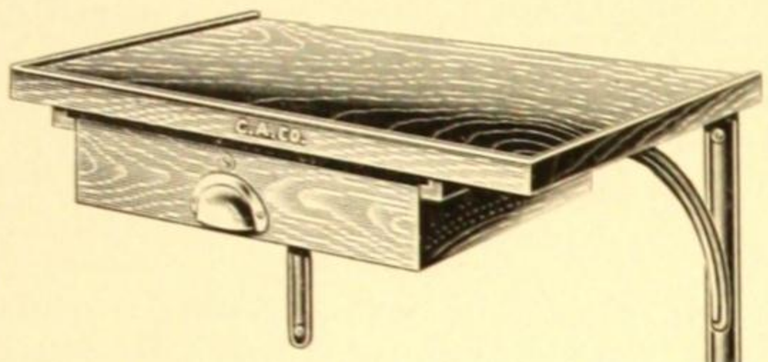
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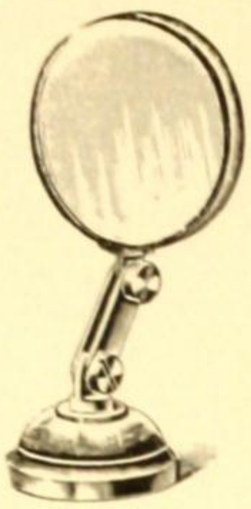
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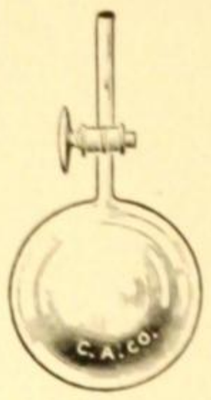
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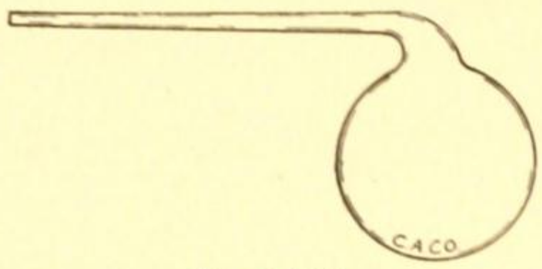
No. 190B.



No. 191B.



No. 192B.



No. 193B.

186B. Balance Rests, New Shock Absorption Type. Each rest is an assembly of three parts; a brass base 34 mm. diameter, a large soft rubber cushion, and a brass crown so countersunk as to provide a good resting place for the tip of a leveling screw or leg of a balance. The large rubber cushion absorbs the shocks and vibrations so destructive to the sensitivity of delicate balances, and so annoying when making weighings. The use of these rests under delicate balances will, therefore, prolong their useful life, and eliminate the delays and annoyances which would otherwise result from shock and vibration. A small hole through the center of the base permits of fastening these rests permanently on a balance shelf or table by means of small screws or nails. The brass parts are finely finished in gold lacquer to harmonize with fine appearance of analytical balances. Per set of three **$3.00**

186Ba. Balance Rests, Glass. For use under the leveling screws of balances. Diameter, 45 mm. Each. **$0.25**

187B. Bench. For supporting tumbler or beaker used in specific gravity work. Top surface measures 20x7 cm. and legs are 9 cm. high. For use with Balance No. 40B, 42B, 49B or 54B. Of sheet metal, black-enameled **$0.25**

189B. Forceps. Brass, gold lacquered, curved tips. Length 9.5 cm..... **$0.15**

194B. Forceps. Gold lacquered brass with curved points, ivory tipped for handling weights. Length 9.5 cm..... **$0.90**

190B. Balance Bracket. Of finely finished wood with drawer for attachment to wall. Top surface measures 20x14 inches and is provided with raised edges. **$14.00**

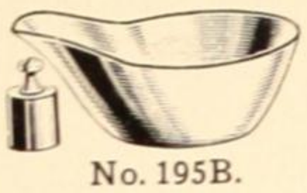
191B. Index Magnifying Glass. To be placed before the index plate, making it easier to follow and read the oscillations of the pointer. The enlarging lens, 38 mm. diameter, is mounted in a nickel-plated adjustable stand **$5.50**

192B. Balloon, Glass, Spherical. With one stopcock. For use in ascertaining the density of a gas by weighing a known volume. The exact volume of this bulb can be determined from the weight of the water required to fill it. Filling with either water or gas is best done by first exhausting the bulb with a high vacuum pump, like our No. 4410R, and then holding it under water in one case, and connecting it to the gas supply in the other. Of glass, with capillary stopcock and connecting tube..... **$1.80**

192Ba. Balloon, Glass, Spherical. With two stopcocks. Easier to fill than the single stockcock type. Either water or gas can be drawn in through one tube by applying suction to the other..... **$2.80**

193B. Balloon, Glass, Dumas Type. Made of light glass with tubulature drawn out to a point for sealing. Capacity, about 200 cc..... **$0.30**

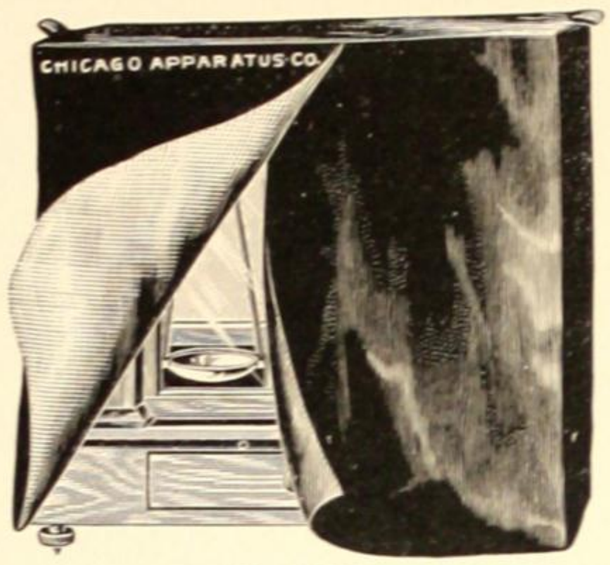
Balance Accessories—Cont.



No. 195B.



No. 197B.



No. 196B.

195B. **Weighing Scoop and Counterpoise.** Made of pure wrought nickel, with pour-out. Diameter 80 mm., length over all 100 mm. $4.50

196B. **Balance Covers, of Black Rubber Cloth.** For protecting analytical balances against dust, etc. With end flaps for lifting, two-inch overlap in front, and of a length to fully cover the balance. Of best quality heavy rubberized cloth. Sizes other than those given below are made to order only. Measurements of length, width and depth of balances must accompany such special orders.

No.	A	B
For balances measuring overall, inches	16½x18½x9¼	16¾x20½x9½
Each	$2.50	2.50

No.	C	D
For balances measuring overall, inches	16½x16½x9¾	19½x20x12
Each	$2.50	2.50

197B. **Level, Round.** For leveling up balances, shelves, tables, drying ovens, incubators, etc. Diameter 25 mm. $1.75

198B. **Watch Glasses, Balanced.** Paired and accurately counterpoised for analytical work.

Diameter, mm.	62	75
Per pair	$1.00	1.00

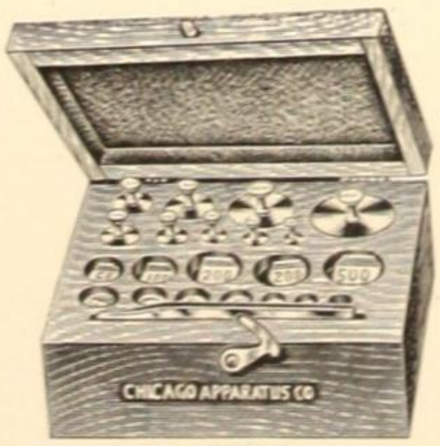
Weights of All Kinds

200B. **Weights, Metric, Analytical.** For student use. Grade "B" adjustment as per U. S. Bureau of Standards' specifications. All adjustments are made on knob stem; no loose balancing material used. Weights are polished and fitted into a natural mahogany block, with velvet-lined hinged cover. Every weight is in separate hole or compartment. Brass forceps are also fitted in block.

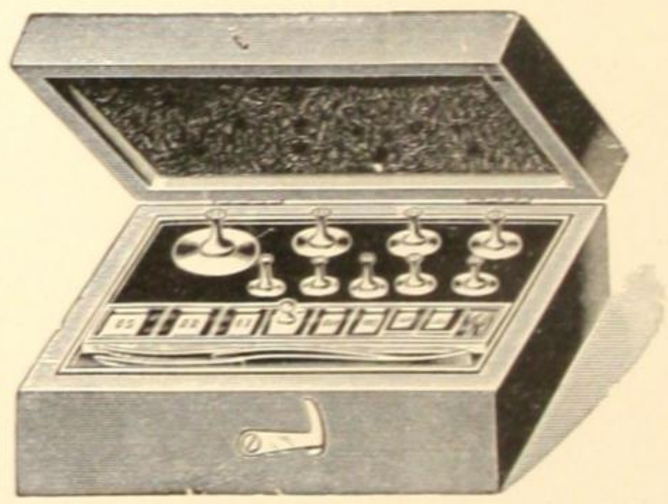
Size, 1 mg. to grams	50	100
Per set	$12.00	14.00

202B. **Weights, Metric, Analytical, Precision Grade, Gold Plated.** Adjusted by the manufacturer to within the tolerance of the U. S. Bureau of Standards' specifications for Class S Analytical weights. Gram pieces of brass, heavily gold plated; milligram pieces from 500 to 50 mg. of solid platinum; 20 to 1 mg. pieces of aluminum. In polished mahogany velvet-lined box, with hinged cover, ivory tipped forceps, and three 10 mg. riders.

Size, 1 mg. to grams	50	100
Per set	$26.00	29.00



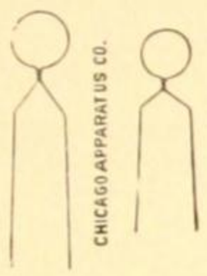
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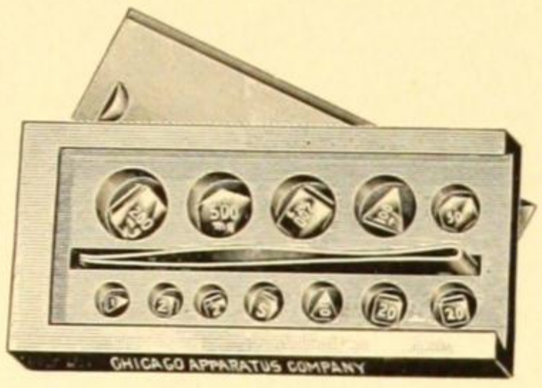
Nos. 202B-204B.

204B. **Weights, Metric, Analytical, Certified.** Similar to No. 202B, but made to qualify for certification under the U. S. Bureau of Standards' specifications for Class S analytical weights. Each set is submitted by us to the U. S. Bureau of Standards and is furnished complete with their certificate showing the divergence of each weight. Gram pieces of brass, gold plated; 500 to 50 mg. pieces of solid platinum; 20 to 1 mg. pieces of aluminum. In velvet-lined mahogany box with hinged cover, ivory tipped forceps, and three 10 mg. riders.

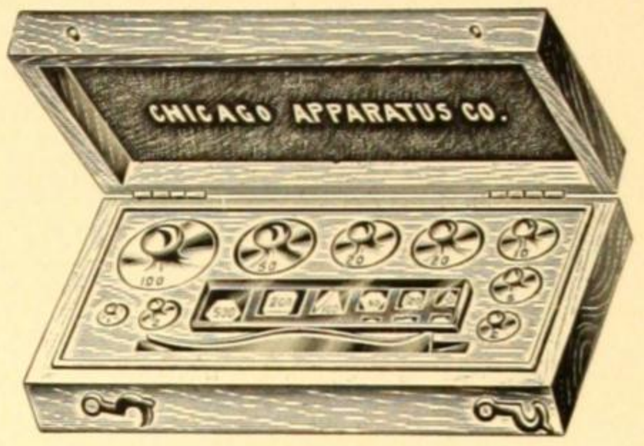
Size, 1 mg. to grams	50	100
Per set	$67.50	73.50



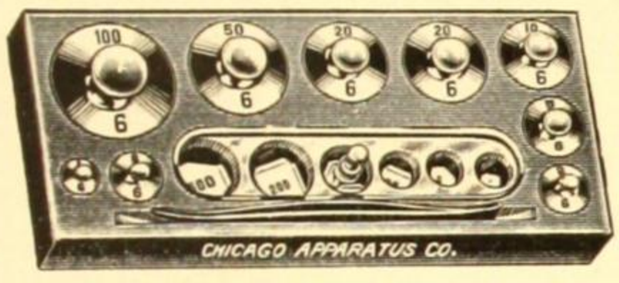
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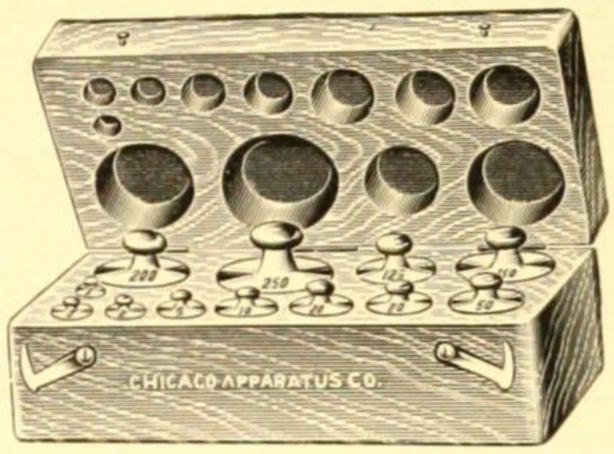
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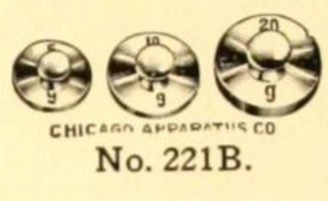
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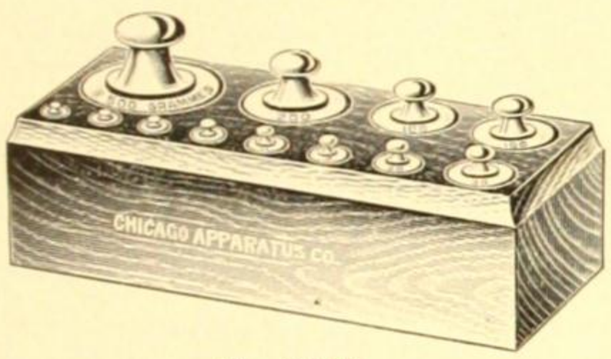
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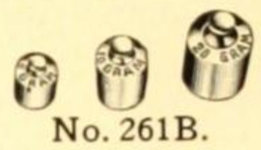
No. 253B.



No. 221B.



No. 251B.



No. 261B.

199B. Riders, Analytical. Aluminum, very accurately adjusted.

Size, mg.	12	10	6	5	3
Each	$0.25	.25	.25	.25	.25
Size, mg.	2	1.2	1	.6	.5
Each	$0.25	.25	.25	.25	.25

205B. Weights, Analytical, Fractional, Precision Grade. Same grade as in Sets Nos. 202B and 204B. Pieces from 500 to 50 mg. of solid platinum, from 20 to 1 mg. of aluminum, with duplicates of the 1, 10 and 100 mg. pieces. In wooden box with slide cover and compartment for each weight.....$17.00

206B. Weights, Analytical, Fractional, Precision Grade. Single weights as in No. 205B, 500 to 50 mg. sizes of solid platinum, 20 to 1 mg. sizes of aluminum.

Size, mg.	1	2	5	10	20	50	100	200	500
Each	$0.30	.30	.30	.30	.30	1.20	1.80	3.25	4.50

210B. Weights, Metric. Good Grade. In polished block with hinged cover. Gram pieces, brass, polished and lacquered; fractional of aluminum and German silver, each in separate compartment under glass cover; with curved brass weight forceps.

Size, 1 mg. to grams	20	50	100
Per set	$4.00	5.00	6.00
Size, 1 mg. to grams	200	500	1000
Per set	$8.00	11.00	14.00

211B. Weights, Metric. Good Grade. Same style and quality as No. 210B, but in polished hardwood block instead of box, with curved brass weight forceps.

Size, 1 mg. to grams	20	50	100
Per set	$2.25	2.75	3.50
Size, 1 mg. to grams	200	500	1000
Per set	$5.00	6.50	10.00

221B. Weights, Metric. Good Grade. Single brass weights, same style and quality as in sets Nos. 210B and 211B.

Size, grams	1	2	5	10	20
Each	$0.15	.20	.20	.25	.30
Size, grams	50	100	200	500	1000
Each	$0.40	.60	.80	1.60	2.80

241B. Weights, Metric. Good Grade. Brass, polished and lacquered. For use with cream test scales.

Size, grams	9	18
Each	$0.25	.40

251B. Weights, Metric. Medium Grade. For ordinary laboratory work; gram pieces, brass polished; fractionals of aluminum and German silver; in hardwood block with separate compartment for fractional weights.

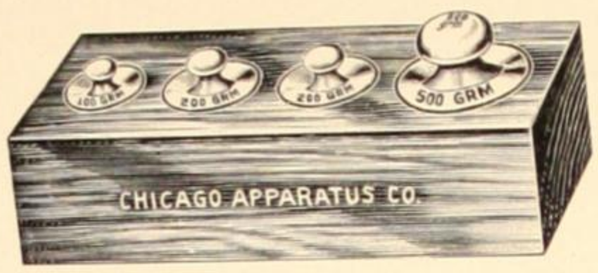
Size	1 cg. to 20 gr.	1 cg. to 50 gr.	1 cg. to 100 gr.
Per set	$1.25	1.50	1.75
Size	1 gr. to 200 gr.	1 gr. to 500 gr.	1 gr. to 1000 gr.
Per set	$2.50	4.00	7.00

253B. Weights, Metric. Medium Grade. Same as No. 251B, but in hardwood block with hinged cover. The two smallest sets are provided with receptacles for the fractional weights.

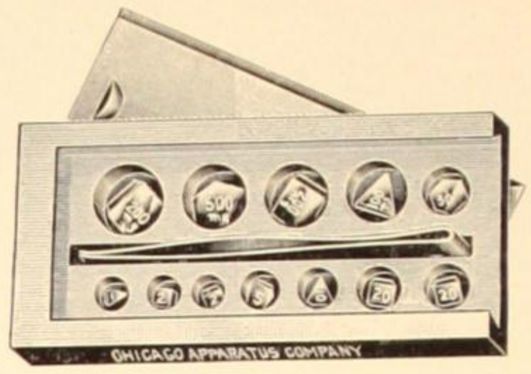
Size	1 cg. to 20 gr.	1 cg. to 50 gr.	1 cg. to 100 gr.
Per set	$1.45	1.65	2.00
Size	1 gr. to 200 gr.	1 gr. to 500 gr.	1 gr. to 1000 gr.
Per set	$2.90	5.00	8.00

261B. Weights, Metric. Medium Grade. Single brass weights, same style and quality as in sets Nos. 251B and 253B.

Size, grams	1	2	5	10	20
Each	$0.08	.08	.10	.15	.15
Size, grams	50	100	200	500	1000
Each	$0.30	.40	.60	1.40	2.50



No. 265B.



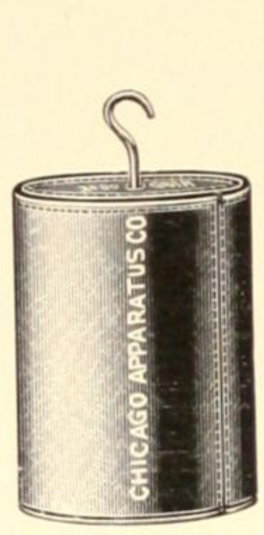
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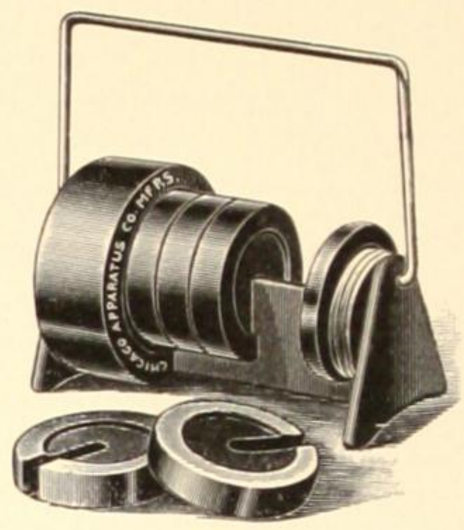
Nos. 281B-286B.



Nos. 291B-294B.



No. 298B.



No. 301B.



Nos. 311B-321B.

265B. Weights, Metric. Medium Grade. This set has been especially designed for use with Double-Beam Trip Scales having a total beam capacity of 100 grams or more. When so used, it extends the weighing range 1000 grams beyond the beam range of the balance. Thus, when used with our No. 166B Double-Beam Balance this set will take care of all weighings from $\frac{1}{10}$th to 1250 grams. One each 100, 200, 200, and 500 gram solid brass weights, of a grade suitable for all ordinary laboratory weighings, in fine wood block **$4.00**

279B. Weights, Metric, Fractional. Made of German silver and aluminum. Set of 1 to 500 milligrams, with duplicates of 2, 20 and 200 milligram pieces, in hardwood compartment box with sliding cover and brass forceps **$1.60**

280B. Weight Block for Fractional Weights. Block with slide cover only of No. 279B. Has 12 compartments for fractional weights and slot for forceps **$0.80**

281B. Weights, Metric, Fractional. Made of German silver and aluminum. Set of 1 to 500 milligrams with duplicates of 2, 20, 200 mg. pieces; in pasteboard box **$0.60**

286B. Weights, Metric, Fractional. Fractional single weights as in No. 281B. 1, 2, 5, 10, 20, 50, 100, 200 and 500 mg. Any size, each..... **$0.07**

291B. Weights, Metric, Iron. Hexagonal, carefully adjusted. Nest of ten weights, from 5 grams to 1 kilo with duplicates of the 20 and 200 gram pieces **$2.75**

292B. Weights, Metric, Iron. Hexagonal, carefully adjusted. Nest of eleven weights, from 5 grams to 2 kilos, with duplicates of the 20 and 200 gram pieces **$4.00**

293B. Weights, Metric, Iron. Hexagonal, carefully adjusted. Nest of thirteen weights, from 5 grams to 5 kilos, with duplicates of the 20, 200 and 2000 gram pieces **$8.00**

294B. Weights, Metric, Iron, Single. Same as in Sets Nos. 291B, 292B and 293B. For replacement.

Size grams	5	10	20	50	100	200	500
Each.....	**$0.15**	**.16**	**.17**	**.18**	**.25**	**.30**	**.50**
Size kilos					1	2	5
Each.....					**$0.65**	**1.35**	**2.50**

298B. Pulley Weight, Milvay Leather-Covered, 2000 gram. Designed after suggestions by the science teachers of St. George High School, Evanston, Illinois. Positively will not mar or injure table tops, like metal weights do, when they accidentally drop due to slippage or breakage of pulley cords. Leather covering is very thick—$\frac{3}{16}$"—providing utmost durability. The large size—11 x 8 cm.—is an advantage in lecture work. Has heavy brass hook and is accurately adjusted to 2000 grams..... **$3.00**

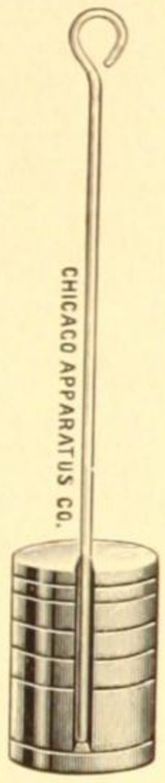
301B. Weights, Metric, Slotted. As used in Millikan, Gale and Bishop's Course. Set consists of one 500, five 100, one 50, two 20 and one 10 gram weights, with holder. Weights and holder of iron, bright finish. Designed to fit No. 321B. Weight Hanger listed below **$3.00**

311B. Weights, Metric, Slotted, Single. Same style as in set No. 301B. For use in connection with No. 321B Weight Hanger, in force, pulley and other physics experiments. For holder, see No. 326B.

Size, grams	1	2	5	10	20
Each.....	**$0.12**	**.14**	**.16**	**.18**	**.20**
Size, grams	50	100	200	500	
Each.....	**$0.30**	**.40**	**.50**	**.60**	

321B. Weight Hanger, for No. 311B Slotted Weights. Brass nickeled; diameter of end plate, 4.5 cm.; length of rod, 13 cm. Weight, 50 grams; capacity, 1500 grams **$0.40**

326B. Weight Holder. Iron, with handle. As furnished with No. 301B set of Slotted Weights. Useful for holding No. 311B Slotted Weights..... **$0.40**



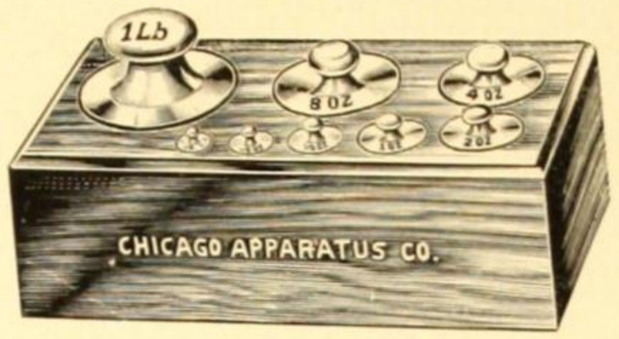
Nos. 331B-336B.



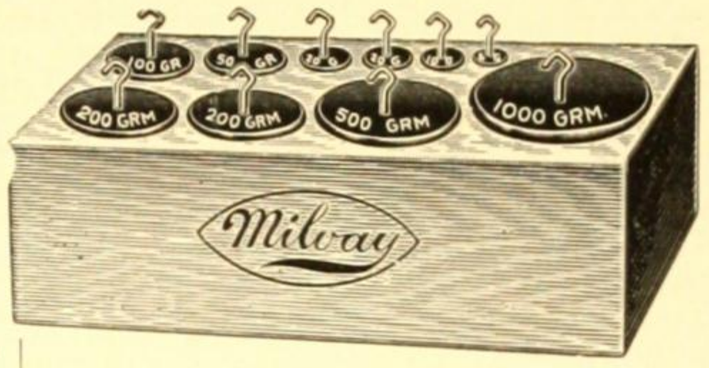
No. 338B.



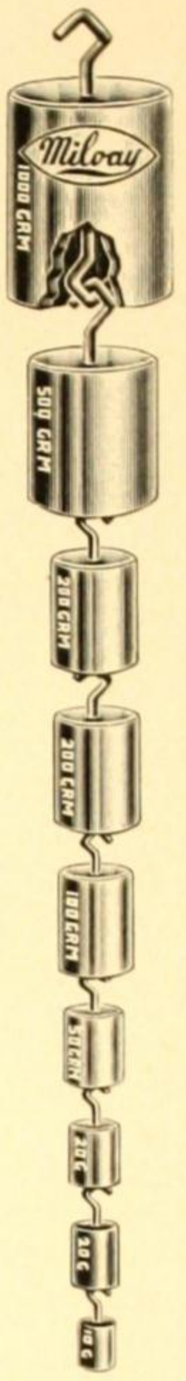
No. 339B.



No. 345B.



(Solid Brass)
No. 352B.



(Solid Brass)
No. 352B.

331B. Weights, Slotted, Metric, for use with No. 336B Weight Hanger, japanned iron; diameter, 95 mm.

Size, kilos	½	1	2	5
Each	$0.50	.65	1.00	2.30

336B. Weight Hangers. For use with No. 331B Slotted Weights, of iron with hook, finished in black enamel. Weight, 1 kilo; diameter of end plate, 95 mm.

No.	A	B
Capacity, kilos	12	20
Overall length, cm.	30	55
Each	$1.05	1.15

337B. Weights, Avoirdupois, Fractional. Of nickel silver, from 1/128 to ¼ oz. Set of six weights, one each 1/128, 1/64, 3/32, 1/16, ⅛ and ¼ oz. **Per set . . . $3.00**

338B. Weights, Avoirdupois. Made of iron, finely finished, round shape, in nest. Satisfactory for all ordinary weighing.

Sets ¼ oz. to	1 lb.	2 lb.	4 lb.	8 lb.
Per set	$0.75	1.50	2.00	3.00

338Ba. Weights, Avoirdupois, Single. Same style and quality as in sets No. 338B. For replacement.

Size, ounces	¼	½	1	2	4	8
Each	$0.35	.35	.35	.40	.40	.50
Size, pounds			1	2	4	
Each			$0.55	.85	1.40	

339B. Weights, Avoirdupois. Made of iron, black japan finish. Pyramid shape with ring handle.

Size, pounds	1	2	5	10	15
Each	$0.70	.80	1.50	2.75	3.75

340B. Weights, Universal, Avoirdupois. Made of solid brass, carefully adjusted. Provided with hook and hole at bottom (like No. 352B) so they may be suspended one below the other or stood upright on a platform scale. Consists of seven weights, ½ oz. to 2 lbs. (32 oz.), in hardwood block **$5.50**

345B. Weights, Avoirdupois, Brass. Medium grade, all pieces of solid brass, carefully adjusted, and polished. In finely finished hardwood block.

Size, ⅛ oz. to lbs.	1	2	4
Per set	$6.00	8.00	11.50

346B. Weights, Avoirdupois, Brass, Single. Same style and quality as in sets No. 345B. For replacement.

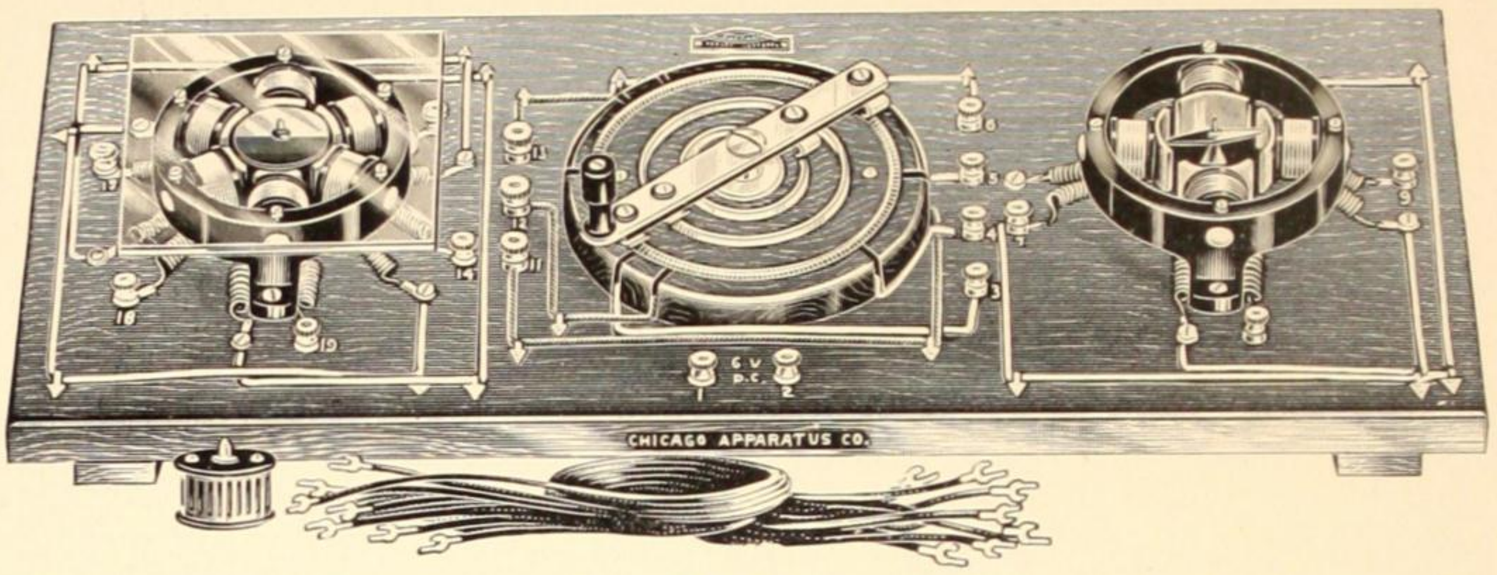
Size, ounces	⅛	¼	½	1	2	4	8
Each	$0.45	.45	.45	.55	.55	.90	1.00

352B. Weights, Universal, Metric. Solid brass. These weights are of solid brass (not lead-filled shells), finely finished, and of a high degree of accuracy. They are provided with a hook at the top and an eye in the bottom, which is concave. This construction enables them to be suspended one below the other, or to be stood upright on a platform scale. These are exceptionally high grade weights, suitable for physical experiments as well as for general weighing in agriculture, chemical and other work. Set of nine weights, ranging from 10 grams to 1000 grams, with duplicates of 20 and 200 gram pieces. In polished hardwood block **$5.95**

361B. Weights, Universal, Metric. Separate, same as No. 352B.

Size, grams	10	20	50	100	200	500	1000	2000
Each	$0.25	.35	.45	.55	.65	.85	1.25	2.50

Electricity—Section E



No. 4E.

4E. Alternating Current Demonstration Apparatus, MILVAY. For studying and demonstrating the essential principles of the predominating alternating current motor types—2 and 3 phase induction motors. The basic principles upon which these motors operate is the moving field (rotating magnetic poles) produced by stationary stator windings. How these moving fields are produced can be easily and strikingly illustrated with this new apparatus.

The MILVAY is a distinct improvement over older forms and offers these important advantages:

(1) Smooth, silent and easy operation with no variation in contact. This has been accomplished by replacing the loose, noisy, open distributor coil with a close flat wound coil recessed in a deep circular groove in a heavy supporting block.

(2) How the distributor converts direct current into polyphase alternating current on either kind can be readily seen and understood because the two output distributor circuits are in separate and distinctive colors.

(3) All connections from distributor to stator coil terminals can be quickly made and changed in accordance with directions because each and every terminal is numbered.

(4) All circuits can be easily traced because they are fully exposed.

(5) Stator design conforms to modern A. C. motor design, the poles carying the field windings being attached to an iron yoke in the shape of a closed ring. Cylindrical pole faces is another detail conforming to commercial motor design.

(6) The squirrel cage rotor or induction armature simulates the commercial type and consists of a series of short circuited copper bars placed on the periphery of an iron core.

(7) The rotating field effect can be beautifully shown. Iron filings sprinkled on a glass plate resting on the stator frames are close enough to the pole faces to be strongly influenced by their changing magnetic action.

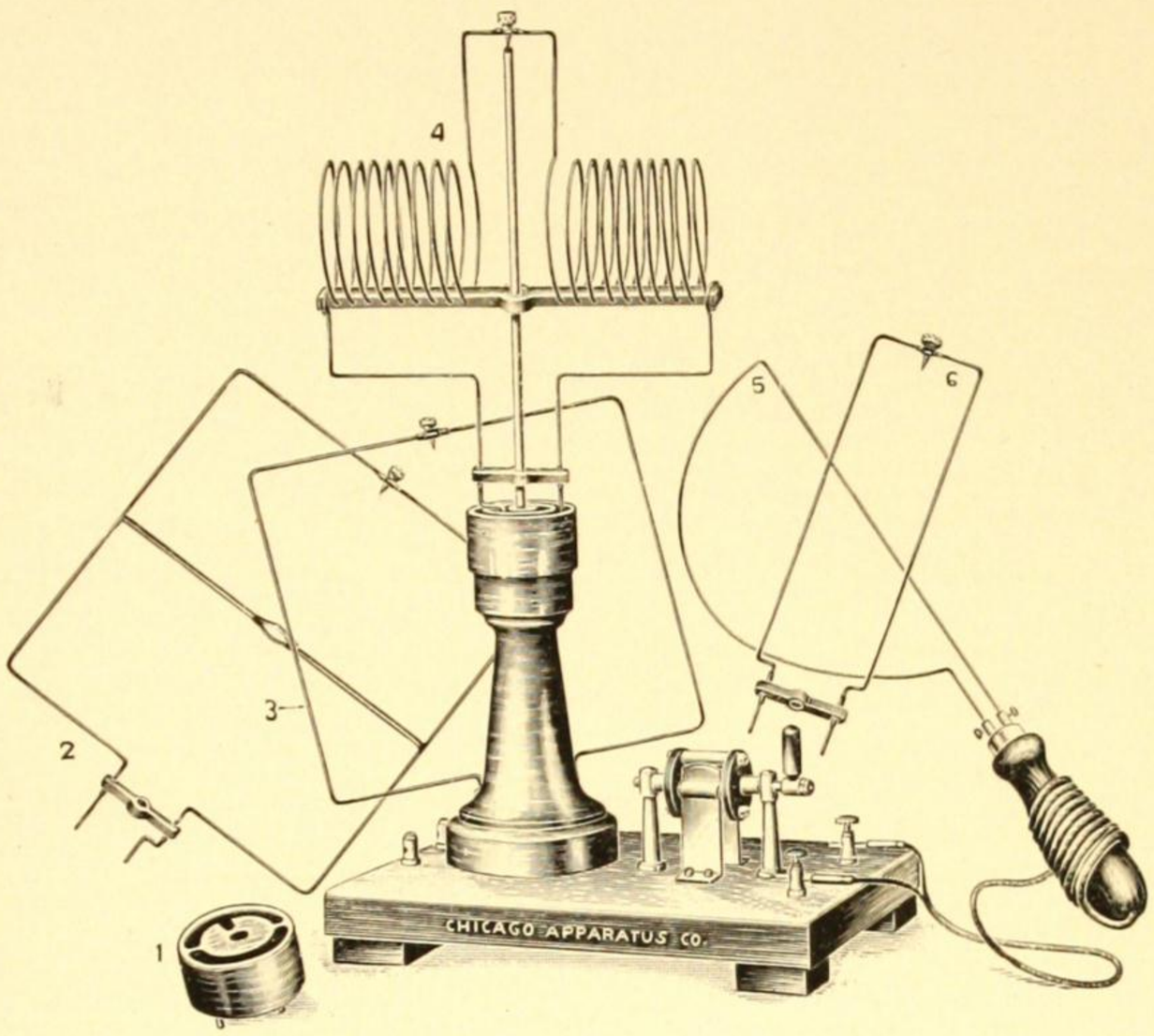
(8) Four-field and six-field stator can be operated simultaneously or independently, just as desired.

The operation of the MILVAY has been simplified to the utmost degree. It is only necessary to connect the terminals of a 6-volt D.C. circuit to the binding posts at the front center of the apparatus. Turning the distributor handle converts the D.C. current into 2-phase and 3-phase A.C. currents. The 2-phase output circuit terminates in four binding posts at the right, while the 3-phase output circuit terminates in three binding posts at the left of the distributor.

The terminals of all the stator field coils are brought out to binding posts on the base. With this arrangement, the four-pole stator can be easily connected into the two-phase circuit and the 6-pole stator in the three-phase circuit. Furthermore, the connections can be quickly changed so as to show the two different systems of connecting 3-phase motors, the reversal of the direction of rotation by the reversal of the connections of one phase and the effect of the wrong connection of phases. The effect produced when connections are correctly made (rotating or moving fields) and the effect of reversed and incorrect connections may be shown by placing the magnetic needle or iron disk on the pivots at the center of the fields where they are free to rotate or otherwise move about under the influence of the field magnets.

As previously explained, the action of the fields may also be shown with iron filings sprinkled on a glass plate resting on the stator frames. The squirrel-cage induction armature can be made to revolve in the center of either the two or three-phase stator, thereby making a complete working model of each type of motor.

Complete, with squirrel-cage armature, magnetic needle, iron disk, glass plate, twelve flexible connecting cords and full directions, on a 30x71 cm. mahogany finished hardwood base **$60.00**



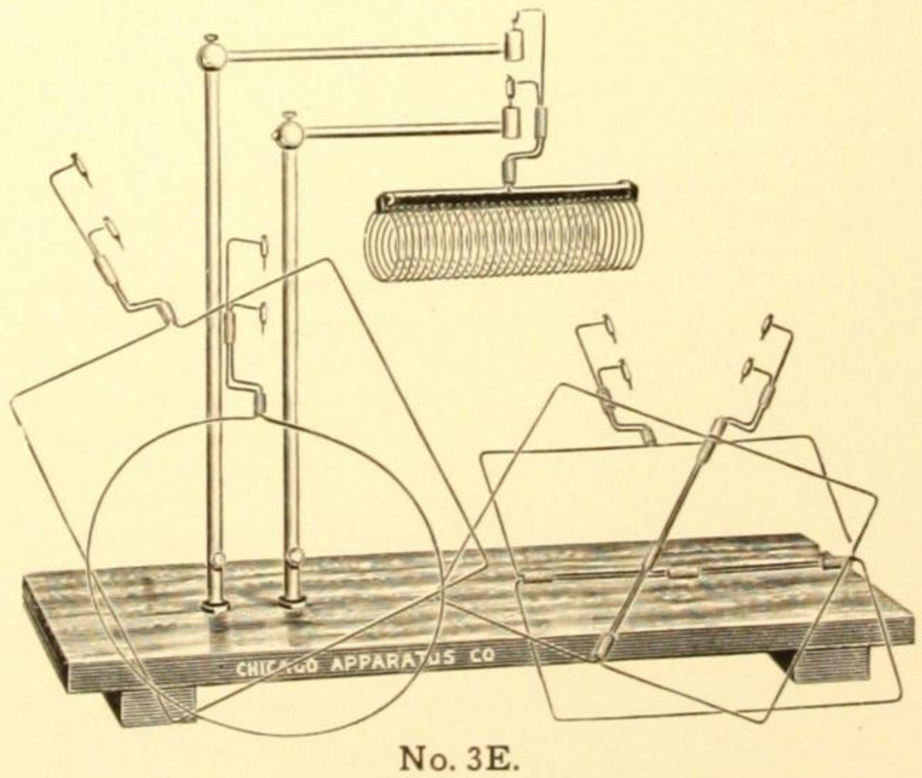
No. 3Ea.

3Ea. Amperes Frame, Single-Pivot College Form. For showing the interaction between the magnetic forces surrounding current-carrying conductors, magnets, and of the earth's field. With this model all demonstrations can be made conveniently, easily and with every assurance of complete success. The single-pivot construction reduces friction to a minimum, thus allowing the frames to turn very freely. The frame terminals are silver-tipped to provide proper contact with the mercury. For convenience in reversing the current flow, a commutator is placed in the circuit and attached to the base. Two mercury troughs with push pin contacts are provided: one with two annular troughs, shown in position for use; the other with a two segment groove (Fig. 1).

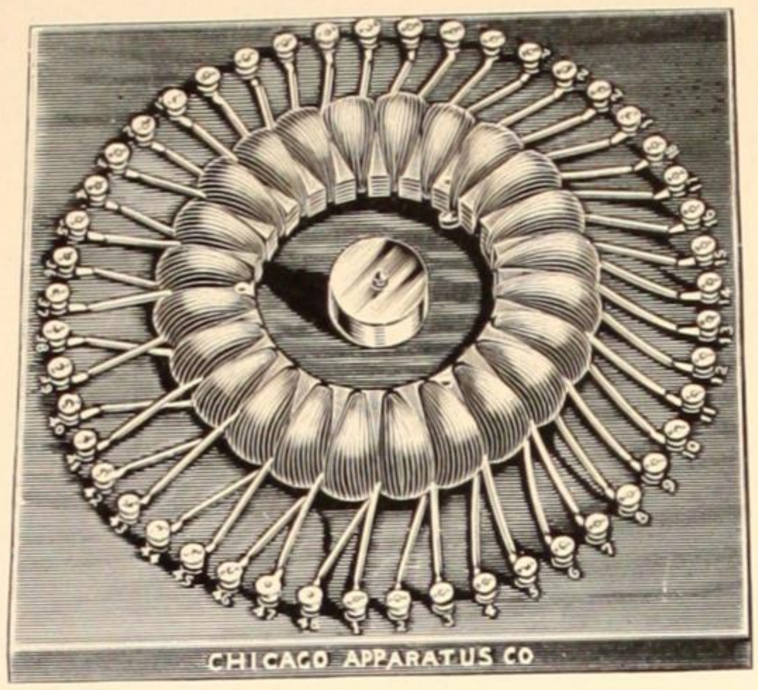
Five frames of aluminum wire are included: Plain rectangle (Fig. 3); Double or astatic rectangle with two horizontal loops (Fig.2); Solenoid (Fig.4); Narrow rectangular loop (Fig. 6); and Half-circle frame in handle, with flexible leads (Fig. 5), for showing the effects produced by parallel and crossed circuits. Best results are obtained by regulating the current flow through the apparatus to a value of 10 to 15 amperes.

On finely finished hardwood base. Overall height, 45 cm. **$35.00**

3E. Amperes Frame. For illustrating the effect of magnets and solenoids upon currents, the action of currents upon currents and the action of terrestrial magnetism. Mahoganized hardwood base, 55x25 cm., brass pillars and arms with steel mercury cups, five aluminum wire frames. (1) Solenoid, 22.5 cm. long; (2) Simple loop, 22.5 cm. diam.; (3) Rectangle, 22.5x22.5 cm.; (4) Astatic rectangle of two vertical loops, 22.5x22.5 cm.; (5) Astatic rectangle of two horizontal loops, 22.5x22.5 cm. Complete with directions **$13.50**



No. 3E.



No. 5E.

5E. Gramme Ring Coil. Designed for use in the study and demonstration of induction motor and phase transformation principles as outlined in "Practical Physics Manual" by Ahrens, Hurley and Burns. When connected into a single-phase circuit, such as an ordinary lighting circuit, with a lamp bank and a coil having self-induction, a current which is approximately three-phase is produced in the Gramme Ring Coil. That this three-phase current produces a constantly changing magnetic field can be shown by the action of iron filings sprinkled on a glass plate placed on the Gramme Ring Coil. If the inverted metallic cup is placed on the pivot at the center, as shown in the illustration, it will revolve rapidly, due to the reaction between the rotating magnetic field in the coil and magnetic field induced in the cup.

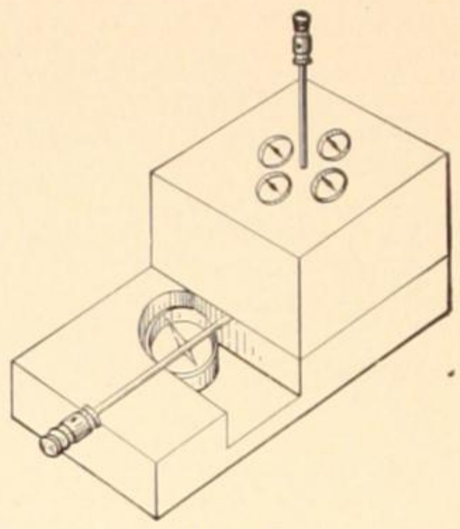
If two connections at the coil terminals are changed, the direction of rotation is reversed. If connection at one of the coil terminals is broken, the cup ceases to rotate. The above are but a few of the many interesting demonstrations possible with this coil.

It consists of 24 windings placed on a slotted and laminated armature, the terminals of each winding, 48 in all, being brought out to separate binding posts, so that connection into circuit can be made in any required manner.

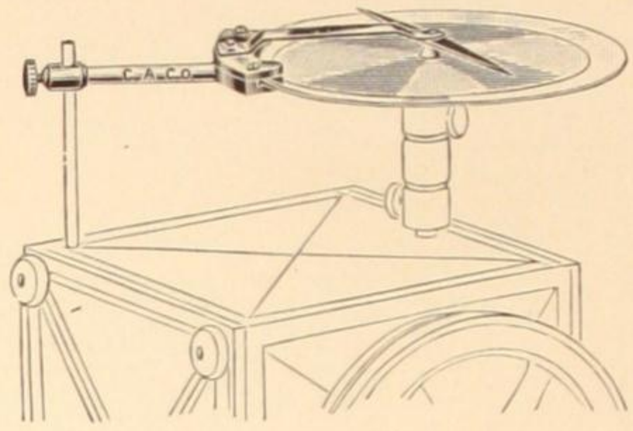
Complete with central pivot and inverted metallic cup, on 38x38 cm. finely finished hardwood base **$60.00**

8E. Ampere's Law Stand. For the study of the magnetic field surrounding a current bearing conductor. Consists of a heavy copper wire, bent at right angles and provided with binding posts at the ends. This wire is mounted in a wood block, so that four small compasses. (Our No. 38M-10 mm.) may be placed around the vertical arm; and a large compass (Our No. 38M-25 mm.) under the horizontal arm. Size, 15x6.5 cm. Without compasses.... **$1.50**

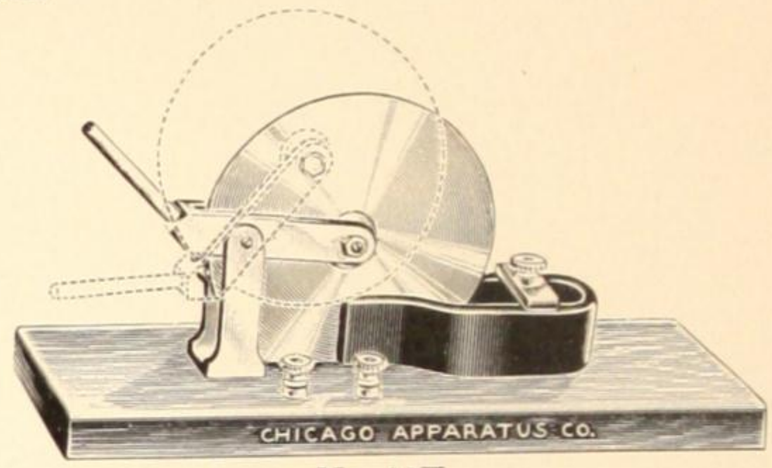
11E. Arago's Magnetic Rotation Apparatus, Milvay. This is an improved form in which the needle cannot get lost. Consists of a revolving copper disc—15 cm. diameter—over which is placed a stationary glass plate having a delicate magnetic needle pivoted at its center. Slow rotation deflects the needle in the direction of rotation, the needle stopping at an angle from the magnetic meridian, depending on the speed. With increasing speed the needle is deflected more and more until it makes complete revolution. Effectively demonstrates Lenz's law—the law governing the action of magnetic drives in speedometers, recording mechanism in wattmeters, etc. Fits any rotator. (Illustration shows the apparatus in use on No. 896R Milvay Gear Drive Rotator). **$9.00**



No. 8E.



No. 11E.



No. 12E.

12E. Barlow's Wheel, Faraday's Disk Dynamo, and Magnetic Brake. For demonstrating the principles of electromagnetism that are most essential to an understanding of dynamo and motor action. It serves three distinct purposes.

1. **As Faraday's Disk Dynamo.** A small quantity of mercury is placed in the slot-shaped trough in the base and a reflecting galvanometer connected to the binding posts. Turning the wheel by hand causes a deflection in one direction. Reversing the rotation of the wheel causes deflection in the opposite direction, indicating reversal of current flow. It will be noted that rotation at uniform speed results in a steady deflection, greater speed in greater deflection and slower in a smaller deflection.

2. **As Barlow's Wheel.** With just enough mercury in the trough to make contact with the edge of the copper wheel the current from a six-volt storage battery is caused to flow through the apparatus. The wheel rotates, the speed depending on the amount of current flow, which can be varied by a rheostat like our No. 920E. Reversing either the direction of the current flow or the polarity of the magnetic field reverses rotation. Reversing both current flow and field polarity does not alter direction of rotation.

3. **As Magnetic Brake.** The wheel is tilted out of the magnetic field and then set spinning, which it will do because of its cone bearings, for some time at uniform speed. Next, it is again set spinning and lowered into the magnetic field, where it will come to rest quite quickly. The magnetic field accompanying the current induced in the wheel opposes the field of the magnet and the reaction between these two fields retards the motion of the wheel—a fine illustration of Lenz's law. This principle is employed in watthour meters, kymographs, and other instruments for controlling registering mechanisms, regulating speed, etc.

As illustrated on finely finished hardwood base **$12.00**

Useful Information About Batteries

No. 1. "B" Batteries. These consist of numerous small dry cells, series connected and molded into convenient solid blocks with suitable terminals. The 22.5 volt size contains 15 such cells and the 45 volt size 30. Like all dry cells, their life is very short when used on circuits drawing excessive current, but under normal service conditions their life is 14 to 16 months. Also they depreciate when idle and after 16 to 18 months, whether they have been in service or not, they will show little or no capacity. Their voltage should be checked occasionally with a HIGH PRESSURE VOLTMETER like our No. 2685E. If less than two thirds the rated voltage the battery is practically exhausted and should be replaced. STANDARD VOLTMETERS, because of their lower resistance and consequent greater current draw, are unsuited for measuring the voltage of "B" batteries, since in such work their readings would be 10 to 50% too low.

No. 2. Bunsen Battery. Prepare a solution by slowly pouring one part of concentrated sulphuric acid (sp. gr. 1.84) into ten parts of water by weight. Place the cylindrical zinc element into this solution and within the zinc place the porous cup containing the carbon element. Fill the porous cup with concentrated nitric acid to which a small quantity of potassium dichromate has been added to suppress the obnoxious nitrogen oxide fumes.

No. 3. Daniell Batteries. Fill the jar with a saturated solution of copper sulphate. Insert the cylindrical copper element and within it place the porous cup containing the zinc element. Fill the porous cup with water and add zinc sulphate crystals. The copper element of the gallon size is provided with a pocket which should be kept filled with copper sulphate crystals. By this means the solution is maintained at the saturation point. The gallon size requires 2 lbs. copper sulphate; the quart size 8 oz. copper sulphate and 1 oz. zinc sulphate.

No. 4. Demonstration Batteries. Both tumbler and Gotham types are designed for use with or without porous cups and with any pair of a wide variety of elements. In simple cell work with copper and zinc elements the electrolyte most commonly used consists of one volume of concentrated sulphuric acid in twenty volumes of water. This same solution is used in studying the effect of elements of different metals (including carbon) on the electromotive force of a cell. To set up as BUNSEN, DANIELL, PLUNGE, OR LEAD-PLATE STORAGE BATTERY, follow instructions given for these various types. In studying the effect of different electrolytes on the e. m. f. of cells follow the formulas given in the manual used. Experiments involving the use of different elements and various electrolytes are described in detail in Millikan and Gale's and other manuals. In both types provision is made for studying the effect of element separation on the internal resistance of a cell. In the tumbler type the various distances with which the elements are set apart are readily measured with a ruler, while in the Gotham type they are indicated on the scale engraved on the side of the jar.

No. 5. Dry Cells. The negative electrode is the cylindrical zinc container and the positive a carbon rod surrounded by a mixture of crushed coke, graphite, and manganese dioxide, the latter acting as a polarizing agent. The electrolyte consists of sal ammoniac to which some zinc chloride has been added. The cell is sealed with asphaltum compound. The open circuit e. m. f. is practically 1.5 volts and the terminal potential on closed circuit about 1 volt. All dry cells depreciate with age whether they have been in service or not and will have very little capacity left after 14 to 16 months. Voltage tests reveal nothing about their capacity. This can be ascertained only by measuring their output on short circuit with an ammeter, which if the cell is in good condition will be from 15 to 30 amperes. Being low in cost, compact, dry, usable in any position, and easily renewed by substitution of new cells, they form a most convenient source of D.C. current for a great variety of laboratory work.

No. 6. Gravity Batteries. Open up the copper element and place it in the bottom of the glass jar with 2 lbs. of copper sulphate crystals. Add water, containing a few drops of sulphuric acid, until the jar is nearly full. Hang the zinc element from the upper edge of the jar. As the sulphuric acid acts upon the zinc, zinc sulphate is formed and since the solution of this salt is lighter than that of the copper sulphate, the liquids stay separated. Short circuit the cell for a while through a resistance of about 10 ohms. When the solution around the zinc is quite clear and that around the copper blue, the cell is ready for service. Should copper deposit on the zinc, brush it off before placing the cell into service.

No. 7. Grenet Batteries. Fill the bowl of the jar (not the neck) with chromic acid solution made by dissolving 160 grams of chromic acid in 1420 cc. of water to which should be added slowly, while stirring, 90 cc. of sulphuric acid. Since the solution consumes the zinc also when the cell is idle, means are provided for raising and keeping the zinc out of the solution when the cell is not being used.

No. 8. Plunge Batteries. Use the chromic acid solution specified in the foregoing paragraph. Like Grenet Cells, Plunge Batteries are also equipped for keeping the elements out of the solution when they are not in use.

No. 9. Samson Battery. The necessary chemicals for preparing the electrolyte come with each battery when purchased. Should it become necessary, as it may after the cell has been in service quite some time, to renew the electrolyte, dissolve 5 oz. of sal ammoniac (ammonium chloride) in sufficient water to properly fill the jar.

No. 10. Simple Voltaic Cell. The solution most commonly used consists of one volume of concentrated sulphuric acid in twenty volumes of water.

No. 11. How to Amalgamate Zincs. To show stoppage of so-called local action in simple cells requires the use of a zinc that has been freshly amalgamated. Because of the continued dissolving action of the mercury such zincs should be prepared shortly before they are to be used. This can be done by first dipping the zinc in a dilute solution of sulphuric acid and then into mercury contained in a small dish. By rubbing with a cloth, the mercury can be spread over the whole surface, thus covering up all the impurities which are the cause of local action. Keep mercury from finger rings as it attacks gold and other precious metals.

No. 12. Demonstration Storage Batteries. Fill the jar with electrolyte prepared by slowly adding one volume of concentrated sulphuric acid to twenty volumes of water. Since this cell should be charged during the same laboratory or lecture period that its discharge characteristics are to be studied, it should be charged for about ten minutes with a 6-volt D.C. current supplied by a suitable generator, storage battery, or other source. So charged it will ring an ordinary electric bell, sound a buzzer, and register 2 volts on a voltmeter.

Useful Information About Batteries—Cont.

No. 13. Open Jar Type Lead-Plate Storage Batteries. Handle elements carefully when taking them out of the packing cases and remove any foreign substances which may have become lodged on them. Suspend the plates in the jar and add electrolyte prepared by slowly pouring one volume of c. p. concentrated sulphuric acid (sp. gr. 1.84) into 4.5 volumes of distilled water, until the plates are well covered. By hydrometer test, the above mixture should test 1.200. If not, add more acid. Charge for 30 hours with a Rectox or similar charger when the cell will be ready for use. Additional directions are contained in the following paragraph.

No. 14. Portable Type Lead-Plate Storage Batteries. This type comes filled with electrolyte and charged ready for use. To recharge use a Rectox or other charger. Such chargers operate on 110-volt A.C. lighting circuits and deliver a charging current at 7.5 volts pressure, which is suitable for charging 2, 4, and 6-volt batteries. Any other D. C. supply also may be used for charging, but the voltage at the battery should not exceed 2.5 volts per individual cell. Only distilled water should be added to replace loss from evaporation. Other waters contain injurious impurities. All capacity ratings are for 8 hours' continuous discharge. Thus a 100 ampere-hour battery will discharge 12.5 amperes steadily for 8 hours. The rating drops to 75% if the discharge rate is doubled, and to 50% if quadrupled. Condition of charge or discharge is best determined with a tester of the hydrometer type. It should show 1.150 at the end of discharge and 1.225 on full charge. Readings, however, will be too high if water has not been added to bring the liquid in each cell up to the normal level. A voltmeter may also be employed, but readings are valueless unless taken on closed circuit, i. e., while the battery is doing work. A reading of 1.9 volts will then indicate 80% discharge and 1.8 volts practically total discharge. At this point the battery should be placed immediately in the charging circuit. With ordinary care, lead-plate storage batteries will stand 300 to 400 complete cycles of charge and discharge.

No. 15. Edison Storage Batteries. These batteries are furnished filled with electrolyte but not charged. The correct charging voltage is 1.8 volts per cell and the normal time of charge is 7 hours. The normal discharge rate is 5 hours during which time the cell drops from an open circuit voltage of 1.4 to about 1.0 volts. Since no water is formed on charge or discharge, the sp. gr. does not change as with a lead cell. Condition of charge, therefore, cannot be determined by the hydrometer method, but can be determined approximately with a voltmeter. Readings should be made on closed circuit, i. e., when the cell is doing work. If doubt exists, the cell can be charged as it will withstand indefinite charging without injury. Only distilled water should be used to replace loss from evaporation. Ordinary tap water contains impurities which reduce the capacity of the cell. The valve in the top of each cell should be kept free from incrustation since if it sticks, high pressure will be developed within the cell, causing the sides to bulge. If after long service it should be found necessary to renew the electrolyte, the old electrolyte should first be drained out and the cell thoroughly rinsed with distilled water. The fresh electrolyte, which can be obtained from us in 2 pound and 5 pound sealed cans, should then be introduced into the cell.

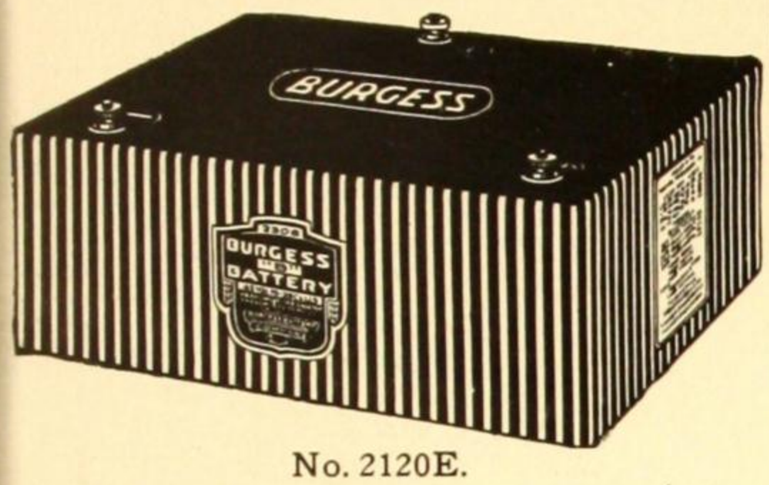
Batteries of All Kinds



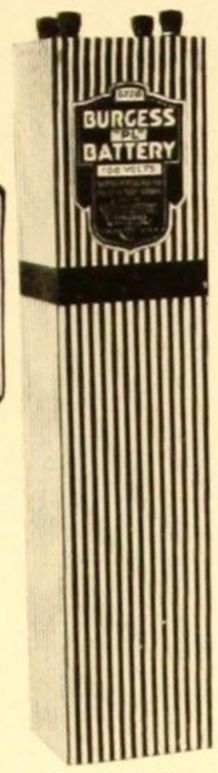
No. 2100E.
"B" Batteries

2100E. Battery "B," Burgess, 22½ volt. Consists of 15 cells connected in series and molded in a compact block with four brass binding post terminals as follows: negative, plus 6, plus 18, and plus 22½. This provides taps to give either 4½, 6, 12, 16½, 18 or 22½ volts. Because of the high quality and long life of Burgess "B" Batteries they are very popular with radio users and well adapted for physical laboratory work requiring high potential battery sets. Length, 4⅛ inches; width, 2⅛ inches; height, 2¾ inches; weight, 1 pound 9 ounces. (See Paragraph No. 1, Page 31) **$1.65**

2110E. Battery "B," Burgess, 22½ volt. Consists of 15 cells connected in series molded in a compact block with three brass binding posts as follows: negative, plus 18 and plus 22½. This provides taps to give either 4½, 18 or 22½ volts. Length, 6⅝ inches; width, 4 inches; height, 3 inches; weight, 5 pounds. (See Paragraph No. 1, Page 31) **$1.75**



No. 2120E.



No. 2122E.

"B" Batteries—Cont.

2120E. Battery "B," Burgess, 45 volt. Consists of 30 cells connected in series molded in a compact block with three brass binding posts as follows: negative, plus 22½ and plus 45. Provides voltages of 22½ and 45. Two of these batteries provide voltages of 22½, 45, 67½, and 90; while three will provide voltages up to 135, and four voltages up to 180; etc. Length, 7⅞ inches; width, 6⅝ inches; height, 3 inches; weight, 9 pounds 10 ounces. (See Paragraph No. 1, Page 31).....**$2.50**

2122E. Battery "B," Burgess, 144 volt. Model PL, special high potential type. Consists of 96 cells connected in series and molded into a compact block with three insulated-nut binding posts as follows: negative, plus 54 and plus 144; providing voltages of 54, 90 and 144. Special attention has been given to inter-cell connections, protection against moisture, etc. The result is very slow deterioration when not in use, about 7% the first 12 months. This cell is particularly useful in photo-electric cell work, in plate and grid circuits used in connection with vacuum tubes, for charging electroscopes, and other high potential work involving small current drain. Size, 3⅛x3⅛ by 14¼ inches high. (See paragraph No. 1, page 31).....**$9.60**

Bunsen Battery and Renewals

13E. Battery, Bunsen. Excellent for open circuit work, operating bells, induction coils, small motors, etc. E. M. F., 1.9 volts; internal resistance, 1.86 ohms. Quart size, complete without chemicals. (See Paragraph No. 2, Page 31).....**$2.25**

18E. Carbon, with binding post attached.. **.75**

1205C. Glass Jar, 4x5 inches..... **.45**

23E. Porous Cup, round, 2x4 inches..... **.30**

28E. Zinc Cylinder, with binding posts attached **1.25**

Daniell Batteries and Renewals

33E. Battery, Daniell. Quart size. An excellent battery for student and demonstration use. Gives a constant E. M. F. of 1.08 volts. Consists of a glass jar, porous cup, zinc element, and copper element. Without chemicals. (See Paragraph No. 3, Page 31).....**$1.00**

38E. Copper, 10x10 cm., with wire attached **.20**

1205C. Glass Jar, 4x5 inches ..... **.45**

23E. Porous Cup, round, 2x4 inches..... **.30**

43E. Zinc, 10x2.5x0.6 cm., with wire attached **.16**

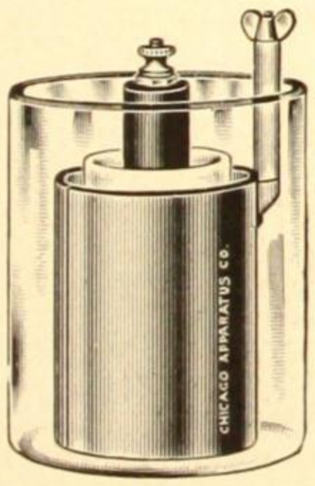
48E. Battery, Daniell. Gallon size. The most popular cell for laboratory use in either closed or open circuit work. Gives constant E. M. F. of 1.08 volts, which remains the same during the life of cell. Consists of glass jar, copper with riveted pocket for copper sulphate crystals, porous cup, and zinc with binding screw. (See Paragraph No. 3, Page 31).....**$3.00**

53E. Copper, with riveted pocket..... **1.00**

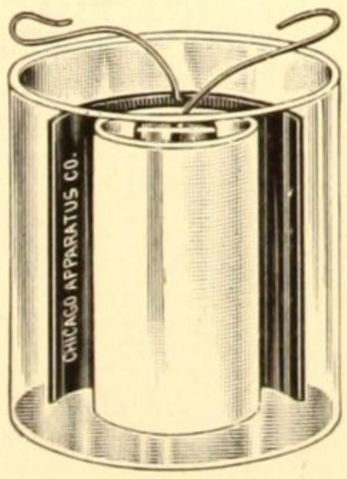
1207C. Glass Jar, 6x8 inches..... **.85**

58E. Porous Cup, 3x7 inches..... **.60**

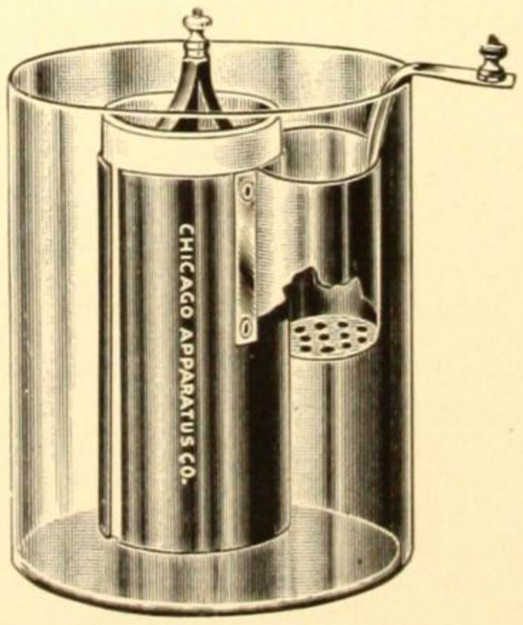
63E. Zinc, weight about two pounds, with binding screw attached ..... **.75**



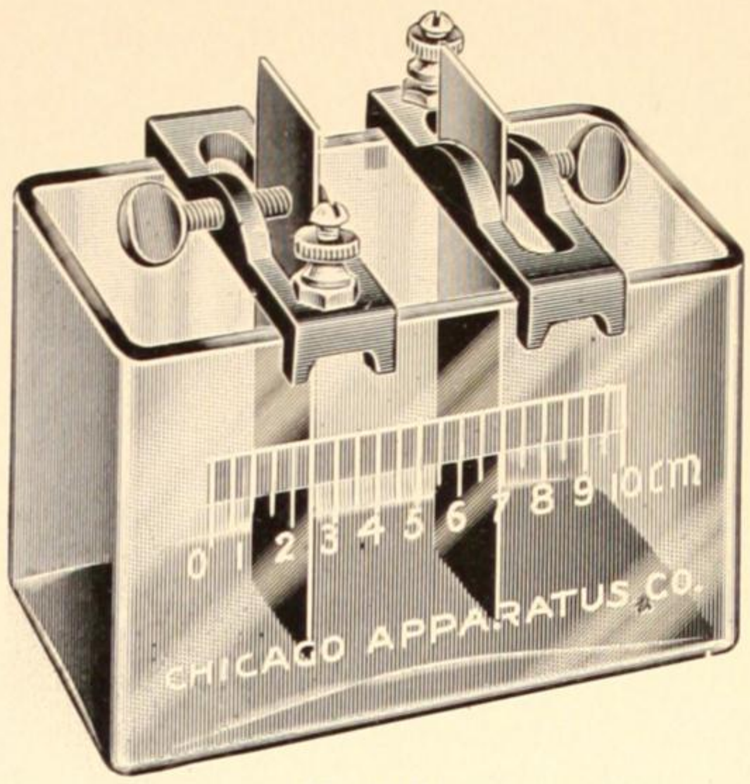
No. 13E.



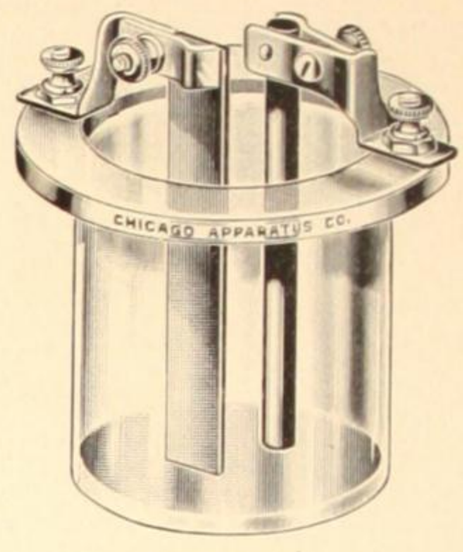
No. 33E.



No. 48E.



No. 68E.



No. 91E.

Demonstration Gotham Batteries and Renewals

68E. Battery Demonstration, Gotham. Consists of two non-corrosive vanadium metal element holders; rectangular glass jar 16 cm. long, 8 cm. wide, 10.8 cm. deep, with etched scale 10 cm. long, reading to mm.; flat copper element 12.5x3.8 cm. and flat zinc element 12.5x3.8 cm. Sticking of the screws due to corrosion—the chief disadvantage of other demonstration cells—is impossible in the Gotham cell because the holders are made of non-corrosive metal. The effect of separation of the elements upon the current can be studied with ease and accuracy. The element holders are movable along the top of the glass jar, while the separation of the elements can be measured by means of the etched scale. (See Paragraph No. 4, Page 31) **$4.00**

73E. Battery Demonstration, Gotham, Complete. Consists of graduated glass jar, two element holders, porous cup, flat aluminum, flat carbon, flat copper, flat iron, flat lead, flat nickel, flat tin, flat zinc, round carbon, and square zinc elements listed below. For demonstrating a storage cell use one Gotham Cell and two flat lead elements. For demonstrating a Nodon Valve (Alternating Current Rectifier) use four Gotham Cells, four flat aluminum and four flat lead elements and a solution of rectifier salts. (See Paragraph No. 4, Page 31) **$5.25**

78E.	**Element, Aluminum,** flat, 12.5x3.8 cm..	.06
79E.	**Element, Carbon,** flat, 12.5x3.8 cm.....	.20
80E.	**Element, Carbon,** round, 12.5x1 cm....	.10
81E.	**Element, Copper,** flat, 12.5x3.8 cm.....	.10
82E.	**Element, Iron,** flat, 12.5x3.8 cm.....	.05
83E.	**Element, Lead,** flat, 12.5x3.8 cm.....	.08
84E.	**Element, Nickel,** flat, 12.5x3.8 cm.....	.20
85E.	**Element, Pure Tin,** flat, 12.5x3.8 cm...	.15
86E.	**Element, Zinc,** flat, 12.5x3.8 cm.....	.05
87E.	**Element, Zinc,** square, 12.5x1x1 cm....	.10
88E.	**Element Holders,** with binding post and thumb screw, each.....	1.00
89E.	**Glass Jar,** 16x8x10 cm. deep, graduated.	2.00
90E.	**Porous Cup,** rectangular, 2x7x9 cm....	.35

Demonstration Batteries and Renewals

91E. Battery, Demonstration, Milvay Molded-On Glass Rim Type. In this new design the jar and rim are of one molded piece of glass—the first improvement in this general form of students' cell since its introduction about 25 years ago. The advantages of this new design are:

1. It eliminates the loose cap or top, which readily pulls off from the tumbler when the connecting wires are strained by the shifting of accessory apparatus, or when they are accidentally brushed or bumped into.

2. It prevents spillage of solutions and its attendant mess, because the increased weight and squat shape provides far greater stability.

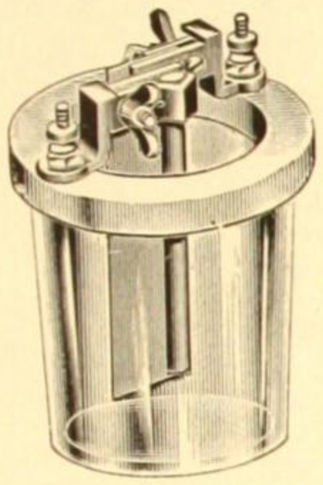
3. The elements can be separated much farther apart—nearly 6 cm., making this new design useful in studying the effect of element spacing on internal resistance.

4. The jar with its molded-on rim, being made of extra heavy glass, is far more proof against accidental breakage.

5. Since rim and jar are inseparable, this cell is always ready to be placed into service. No broken, misplaced, or ill-fitting tumblers or jars to replace.

6. The increased internal dimensions provide more room for a porous cup, making it easier to assemble the Daniell type of battery.

With the addition of a complete set of elements listed on page 35 (No. 108E) and porous cup (No. 109E) practically every important type of battery can be readily assembled—Bunsen, Daniell, Gravity, Le-Clanche, and Simple Voltaic. The jaws will hold either round or flat elements (Nos. 78E to 110E), are adjustable, and insulated from each other so that they cannot short circuit the elements. As illustrated, with No. 102E Copper Element and No. 107E Zinc Element. (See Paragraph No. 4, Page 31) **$1.25**



No. 93E.



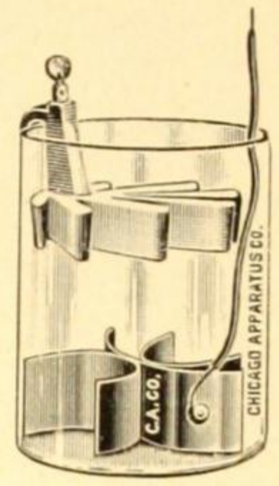
No. 113E.



No. 114E.



No. 116E.



No. 128E.

Demonstration Batteries and Renewals—Cont.

93E. Battery, Demonstration, Student's. With extra large rim—will fit tumbler or 4x5 inch battery jar. An ideal cell for student use in the study of the laws of the voltaic cell, internal resistance, use of various solutions, etc. With the complete set of elements listed below (No. 108E) the following forms of batteries are readily assembled—Bunsen, Daniell, Gravity, Grenet, Le Clanche, and Simple Voltaic.

The cap of porcelain is acid proof and will not warp. The clamps will hold either flat or round elements; being adjustable, the distance between the elements can be varied at will. The clamps, being insulated from each other, cannot short-circuit the elements. Battery consists of No. 633W Tumbler, No. 99E Cap, No. 107E Zinc Element and No. 102E Copper Element. (See Paragraph No. 4, Page 31) **$1.00**

98E. Battery, Demonstration, Student's Complete. With extra large rim—will fit tumbler or 4x5 inch battery jar. Consists of No. 633W Tumbler, No. 99E Cap, No. 109E Porous Cup and set of elements listed below, No. 108E. A very complete electromotive series can be determined with this outfit. (See Paragraph No. 4, Page 31) **$1.65**

99E. Cap, Porcelain. With extra large rim—will fit tumbler or 4x5 inch battery jar. Complete with element clamps as used in No. 93E and No. 98E batteries **$0.75**

100E. Element, Aluminum, flat, 12.5x2 cm..... .06
101E. Element, Carbon, flat, 12.5x2 cm..... .15
80E. Element, Carbon, round, 12.5x0.8 cm... .10
102E. Element, Copper, flat, 12.5x2 cm..... .05
103E. Element, Iron, flat, 12.5x2 cm..... .05
104E. Element, Lead, flat, 12.5x2 cm..... .06
105E. Element, Nickel, flat, 12.5x2 cm..... .15
106E. Element, Pure Tin, flat, 12.5x2 cm..... .10
107E. Element, Zinc, flat, 12.5x2 cm..... .05
87E. Element, Zinc, square, 12.5x1x1 cm.... .10
108E. Elements, Set of Ten, one each of the elements listed above, per set..... .75
109E. Porous Cup, 3x7.5 cm. inside..... .25
110E. Element, Zinc, Amalgamated, flat, 12.5x2 cm. (See Paragraph No. 11, Page 31) ..... .15
633W. Tumbler, heavy glass; diameter, inside, 73 mm. ..... .10

Dry Batteries

113E. Battery, Dry, Burgess No. 6. A new battery with an unusually high initial amperage, long life and negligible storage deterioration. These distinctive characteristics are the result of years of research on the part of Burgess experts and produce a battery that is in a class by itself. Initial output 25 to 30 amperes at 1.5 volts. (See Paragraph No. 5, Page 31) **$0.45**

114E. Battery, Dry, Burgess Super-Six. This is a superior dry cell better adapted for laboratory work than ordinary dry cells. Made from specially purified materials; will deliver a small uniform current over long periods of time; has long life and low depreciation over long periods of intermittent use. Height, 6 inches; diameter, 2½ inches; weight, 2.08 lbs. E. M. F. on open circuit, 1.5 volts. (See Paragraph No. 5, Page 31)..... **$0.60**

116E. Dry Cell Protector, Fountain's. For limiting the maximum current drain on dry cells to 0.75 amperes, thereby preventing their rapid exhaustion, a condition which quickly follows when unprotected dry cells are accidentally shorted or used on circuits having too little resistance. In use, as illustrated, the protector is screwed into the center or positive cell post and connection then made to its binding post terminal. The use of this protector will materially lengthen the useful life of dry cells employed in students' experimental work **$0.30**

Gravity Battery and Renewals

128E. Battery, Gravity. Crowfoot type. Ideal for closed circuit work. Extensively used by telegraph companies. E. M. F.—about 1 volt; internal resistance—1 to 5 ohms. Gallon size, complete without chemicals. (See Paragraph No. 6, Page 31.)... **$1.75**

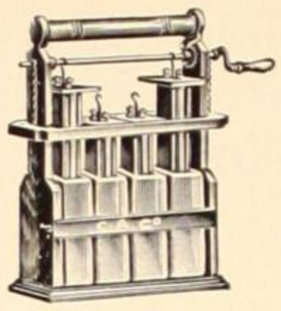
129E. Copper, with wire attached..... .20

1207C. Glass Jar, 6x8 inches ..... .85

130E. Zinc, crowfoot, with binding screw attached ..... .80



No. 133E.



No. 148E.



No. 158E.



No. 165E.

Grenet Batteries and Renewals

133E. Battery, Grenet. Latest French type, pint size. On account of its convenience this cell is ideal for lecture table work. Gives a very powerful current for a short time. Initial E. M. F.—2 volts, low internal resistance. Height of cell, 8 inches. Complete without chemicals. (See Paragraph No. 7, Page 31) **$3.00**

134E. Carbon Elements, with holder. **Per pair** .50

135E. Zinc Element ..... **Each** .40

138E. Battery, Grenet. Latest French type, quart size, 10 inches high. (See Paragraph No. 7, Page 31) **$4.00**

139E. Carbon Elements, with holder.. **Per pair** 1.25

140E. Zinc Element ..... **Each** .45

Le Clanche Battery

This type has been discontinued by the makers and can no longer be supplied. We recommend No. 165E Samson Battery as the most satisfactory substitute.

Plunge Batteries and Renewals

148E. Battery, Plunge, Four Cells. On account of its many advantages this is unquestionably the best battery for the lecture table. The cells may be used singly, in a series or in parallel. The initial output of each cell is about 10 amperes at 2 volts. The case is so designed that the elements may be readily lowered into or raised out of the solution. A dead-fall catch securely holds the elements at any desired height. The elements of any cells not needed may be suspended from the crank axle. Complete with case. (See Paragraph No. 8, Page 31)..... **$25.00**

150E. Carbon Plate only, 6½x2½x¼ inches.. .60

151E. Complete Element, two carbon plates and zinc plate attached to fiber top with binding posts and hook **$2.75**

152E. Glass Jar, 2¼x4¼x7 inches..... .75

153E. Zinc Plate only, 6½x2½x¼ inches.... .50

158E. Battery, Plunge, Milvay, Single Cell. An ideal battery for laboratory and lecture table work. Powerful and compact. Elements can quickly be lifted out of solution when not in use—see illustration. Fibre top with nickel-plated brass trimmings and large zinc and carbon elements; initial E. M. F., about 2 volts; internal resistance when freshly charged, 0.15 ohms. (See Paragraph No. 8, Page 31) **$4.50**

160E. Battery, Plunge, Milvay, Four Cells. In neatly finished wood case with metal handles. (See Paragraph No. 8, Page 31)..... **$22.00**

162E. Carbon Plate. For Milvay Plunge Battery; 4x3x¼ inches **$0.35**

163E. Glass Jar. For Milvay Batteries; 4x4x8 inches **$0.75**

164E. Zinc Plate. For Milvay Plunge Battery; 4⅛x3¼ inches **$0.60**

Samson Battery and Renewals

165E. Battery, Samson. A durable and popular cell of the carbon cylinder type for open circuit work. Recuperates very quickly. E. M. F. 1.5 volts. Internal resistance about 0.7 ohms. Complete with chemicals. (See Paragraph No. 9, Page 31).... **$3.25**

166E. Carbon 1.60

167E. Zinc Cylinder ..... .75



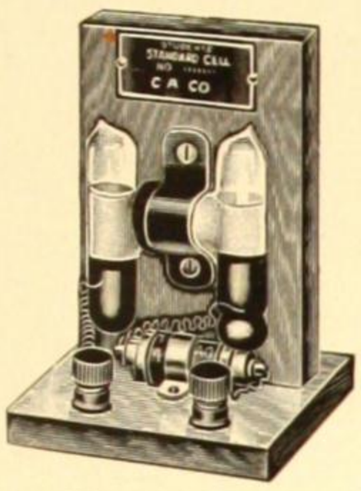
No. 168E.

Simple Voltaic Cell and Renewals

168E. Battery, Simple Voltaic. Consists of No. 633W Tumbler, No. 169E Copper Element, and No. 170E Zinc Element. (See Paragraph No. 10, Page 31) **$0.30**

169E. Element, Copper, flat, 12.5x2 cm., with wire attached **$0.10**

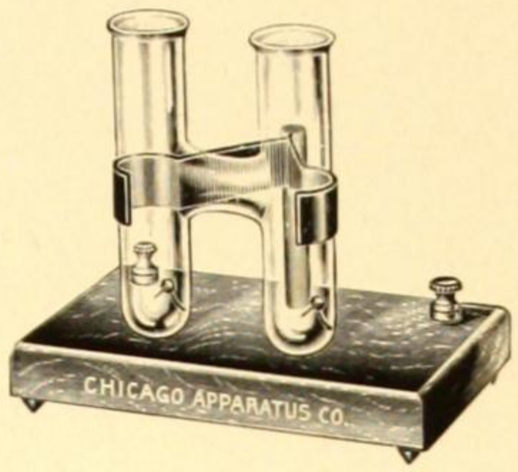
170E. Element, Zinc, flat, 12.5x2 cm., with wire attached **$0.10**



No. 2140E.



No. 2142E.
No. 2143E.



No. 2146E.

Standard Cells

2130E. Battery, Standard Cell, Eppley. Inexpensive form for students' use. A cadmium cell of the unsaturated type mounted on open mahogany support with depolarizer protected against action of light. E. M. F. 1.0186 to 1.0191 volts, nearly. Guaranteed accuracy 1/5%. Useful as a working standard of E. M. F. in potentiometer standardization and measurement work **$10.00**

2140E. Battery, Standard Cell, Eppley. Same as No. 2130E, but with 10,000 ohm protective resistance permanently connected in series with the cell. A single short circuit will ruin standard cells of this kind. Hence, for beginners' use this protected type is safer and less expensive in the long run.... **$15.00**

2142E. Battery, Standard Cell, Eppley, Precision Type. A special low temperature coefficient form for use in precision measurements of electromotive force. Internal resistance not over 500 ohms. Mounted in black bakelite case. Guaranteed to be within 0.01% of certified value. With Eppley Laboratory Certificate **$20.00**

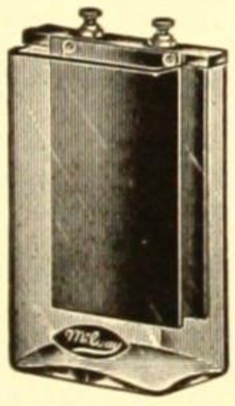
2143E. Battery, Standard Cell, Eppley, Precision Type. Same as No. 2142E, but of low internal resistance—not over 100 ohms. Especially adapted for use with deflection potentiometers. Negligible temperature coefficient. In brown bakelite case. Guaranteed to be within 0.01% of certified value. With Eppley Laboratory Certificate. **Each**... **$25.00**

2145E. Battery, Standard Cell. Glass part only, usual H-form, unfilled and unmounted, but with platinum wire contacts fused in. Useful in making up ordinary standards in the laboratory..... **$1.50**

2146E. Battery, Standard Cell. Same as No. 2145E, but on stand with binding post terminals..... **$3.50**

STORAGE BATTERIES

173E. Battery, Storage, Demonstration, Milvay. As described in Black and Davis' Practical Physics on page 352. Consists of two 9x15 cm. lead plates attached to insulating bar provided with binding posts and a 6x11 x17.5 cm. glass jar. (See Paragraph No. 12, Page 31)..... **$2.50**



No. 173E.

175E. Batteries, Storage, Glass Jar, Open Type.

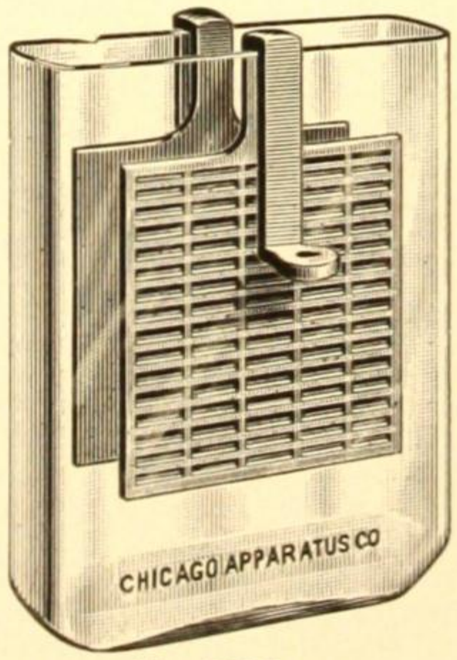
Suitable for all practical purposes and ideal for laboratory use in the study of lead plate storage batteries. The plates are much thicker and much heavier than usual and of the very latest and best design. As a result, these batteries will stand a great deal of abuse and misuse and still give satisfactory service. The rugged plate construction and the consequent durability and long life make these batteries especially valuable in experimental work. The initial voltage of each battery is approximately 2 volts. Guaranteed for one year against defects in workmanship and material. Full directions for charging and handling accompany each cell. (See Paragraph No. 13, Page 32.) Made in six sizes as follows:

Size	Ampere hour Capacity	Number of plates	Size of plates	Size of Jar inches	Complete Cell without electrolite
1	8	2	3x4	1¾x3¾x7	$3.00
2	16	2	5x5	2¼x6¼x8½	4.00

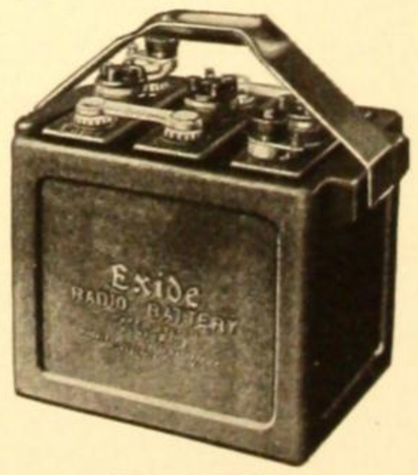
178E. Batteries, Storage, Portable Type, Exide, 6-Volt.

These "A" batteries are made for us by the Electric Storage Battery Company—makers of the famous Exide batteries used in radio, auto starting, ignition, telephone, lighting, power plants, etc. The type here listed is best suited for radio and laboratory work. Exide construction insures dependability and long life, with low cost to the user. The separate cells, three in number, are securely mounted in strong, black composition cases with detachable metal carrying handles. Using test clips, voltages of 2 and 4 in addition to 6 may be tapped off, a convenience in laboratory work. Shipped charged, ready for immediate use. (See Paragraph No. 14, Page 32.)

Size No.	A	B	C	D
Voltage	6	6	6	6
Capacity, ampere hours	50	75	100	125
Number of plates per cell	5	7	9	11
Complete Battery, each	$12.30	14.55	17.65	20.60



No. 175E.



No. 178E.



No. 1500E.



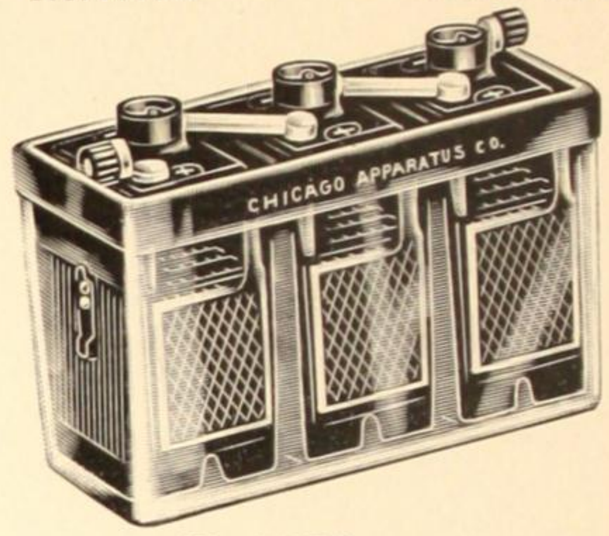
No. 1501E.



No. 1505E.



No. 1506E.



No. 1507E.

1500E. Storage Batteries, Sealed-Glass Cell, Power Type. These improved batteries are particularly suited to conditions of laboratory service because they furnish a maximum of steady current for the space occupied, they will remain absolutely dry and clean on top throughout their normal life, they are easy to install and to maintain, and because their cost is low. They are the product of one of this country's leading and most progressive makers of storage battery units. Features which place these cells in a distinct class by themselves are:

1. **Pressed-Molded Glass Jars.** Almost unbreakable. They have a tensile strength of 5350 lbs. per square inch and dielectric strength of 100,000 volts.

2. **Spray-Proof Funnel Vents.** They prevent the escape of spray during charge, keeping the battery dry and clean. Also, through their condensing action, they reduce evaporation to a minimum, greatly lengthening the intervals between additions of water.

3. **Built-in Charge Indicators.** Two balls in pilot cells show at a glance the condition of charge. When both float, cell is fully charged; when one floats and one sinks, cell is partially charged; and when both sink, the cell is discharged.

4. **Diamond Grid Processed Plates.** Will deliver 100 percent of rated capacity immediately and yet outlast any ordinary pasted plate, because of the unusual degree of hardness imparted to them by the methods employed in their production.

5. **Quarter-Sawed Hardwood Separators.** Cut from old Douglas fir trees. They provide alternate hard and soft vertical layers which afford maximum strength and porosity.

6. **Slotted Hard Rubber Retainers.** These provide additional separator protection and retard plate erosion, prolonging the life of the battery 41 percent.

7. **High Sediment Space.** Eliminates internal cleaning and prevents internal shorts due to accumulation of sediment.

8. **High and Low Water Level Marks.** These are sand blasted on the sides and a glance will tell whether or not cells are in need of water.

9. **Tightly Sealed Cover.** Leakage between cover and jar is entirely prevented by a special method of sealing. This together with the spray-proof vents insures that the battery will remain dry on the outside.

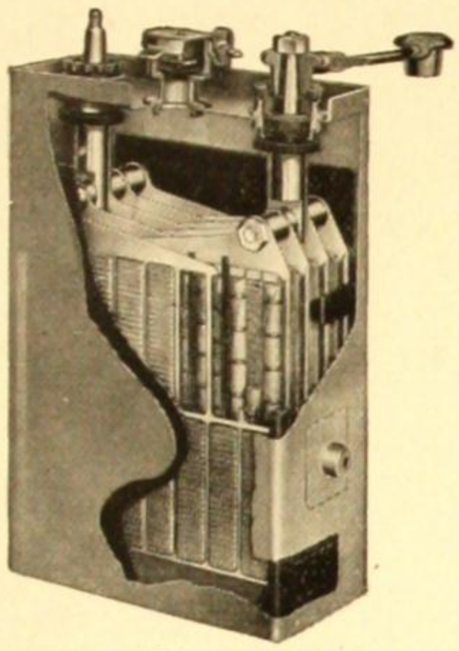
10. **Shipped Dry, but Charged.** These batteries are made up dry with the plates in a partially charged condition. This method of assembly prevents deterioration and eliminates the necessity for a long initial charge. The electrolyte comes in a separate container. As soon as the electrolyte has been put in the cell and allowed to soak for a short time, the battery may be put to work. It will deliver at least 50% of its rated capacity without any initial charging.

Each cell, provided with two terminals having large connecting bolts, delivers 2 volts. Grouping two cells in series, provides a voltage of 4; three cells in series, a voltage of 6; etc. The large size is recommended for all work requiring currents up to 14 amperes, and the small size for all work up to 7 amperes.

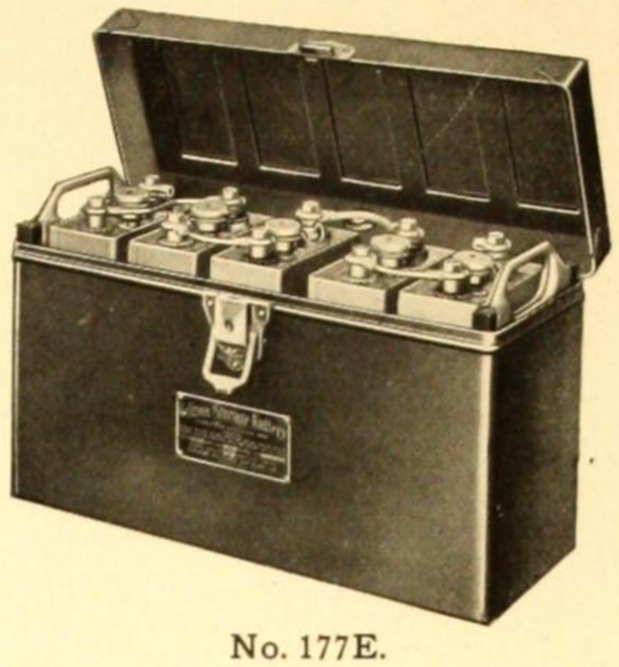
Cat. No.	1500E	1501E
Ampere-hour capacity, 8 hr. rate	60	120
Number of plates	7	13
Overall length, inches	8 3/8	8 3/8
Overall width, inches	4 1/2	6 3/4
Overall height, inches	12 1/4	12 1/4
Each, including electrolyte	**$9.50**	**14.50**

1505E. Batteries, Storage, Sealed-Glass Cell, Intermittent Type. These cells are the same as No. 1500E, but smaller. They have the almost non-breakable jar, perfectly sealed cover, built-in charge indicator, water level lines, high sediment space, and every other feature of the larger power type. They are suitable for many laboratory purposes requiring steady currents falling within their ratings. Being light and extremely portable, they are ideal for lecture table work. Shipped dry with electrolyte in separate container.

Cat. No.	1505E	1506E	1507E
Voltage	2	4	6
Number of Cells	1	2	3
No. of plates per cell	5	5	9
Ampere hour capacity	12-20	12-20	29-38
Overall length, inches	3 5/8	7 1/4	10 3/8
Overall width, inches	2 1/16	2 3/4	4 5/8
Overall height, inches	7 1/4	7 1/4	7 1/4
Each, including electrolyte	**$4.00**	**7.50**	**13.90**



No. 176E.



No. 177E.

Edison Storage Batteries

176E. Batteries, Storage, Portable Type, Edison. In these batteries the negative plates are composed of iron oxide, and the positive plates of nickel oxide immersed in an alkaline solution. The jars are of corrugated sheet steel, welded at the seams, and electroplated with nickel to make them attractive in appearance and to protect them from rust. Made in two types: Type "A" for heavy current duty; Type "B" for lighter work, such as ignition, radio work, operating clocks, bells, small lighting outfits, small motors, etc. Guaranteed for five years if handled according to the simple directions which accompany each cell. Voltage per cell on open circuit 1.2. Edison storage batteries offer many advantages—low maintenance cost—long life—quiet reception in radio work—clean, safe, odorless—easy to handle—full capacity of useful service—foolproof, accidental short-circuiting, charging in reverse direction, complete discharge, or overcharge will not permanently injure them—they are not sensitive to temperature, vibration, or shock. (See Paragraph No. 15, page 32.) The sizes listed below are best suited for laboratory work.

Size No.	1	2	3	4	5	6
Type designation	B1H	B2	B4	B6	A4	A8
Rated capacity, ampere hrs.	18.75	37.5	75	112.5	150	300
Average discharge voltage (8-hr.)	1.24	1.24	1.24	1.24	1.24	1.24
Discharge rate (5-hr.), amperes	3.75	7.5	15	22.5	30	60
Normal charge rate (7-hr.), amperes	3.75	7.5	15	22.5	30	60
Weight, complete cell, lbs	5.2	4.5	7.8	11.3	13.8	26.8
Amount renewal solution per cell, lbs	2.0	1.1	1.9	2.7	3.2	6.4
Complete cell with electrolyte, but not charged	**$6.70**	**8.70**	**12.05**	**16.35**	**20.00**	**38.00**

177E. Battery, Storage, Portable Type, Edison, in Sets. These sets consist of five cells in standard suspension trays contained in a steel battery box. (See Paragraph No. 15, Page 32.) The initial voltage of each set is 6 volts.

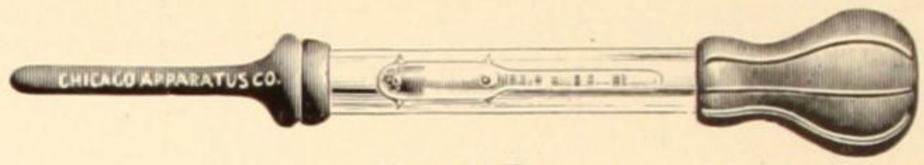
Size No.	1	2
Type designation	B-2	B-4
Capacity, ampere hours	37.5	75
Charging rate, amperes	7.5	15
Charging voltage	9	9
Length, inches	11.9	17.4
Height, inches	10.3	10.3
Width, inches	7.6	7.6
Battery complete, in box	**$48.50**	**65.00**

1510E. Electrolyte for renewal of Edison storage batteries. In original 2-lb. sealed cans. **Per can.....$1.00**

1511E. Electrolyte for renewal of Edison storage batteries. In original sealed 5-lb. cans. **Per can..... 2.00**



No. 180E.



No. 181E.

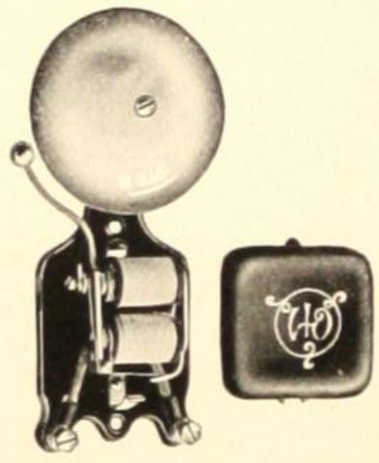
180E. Battery Tester, Chaslyn Ball Type. Invented by Prof. C. E. Linebarger, Lake View High School, Chicago, Ill. The simplest, most convenient and most accurate tester yet devised. When all three balls float the battery is fully charged; when the white ball sinks charge is light, when the green ball sinks the charge is lean, when the red ball sinks the battery is dead. This tester is especially valuable from an educational standpoint for showing the practical application of the laws of flotation and specific gravity. Complete in neat carton with directions and explanation of the principles on which it operates.....**$0.75**

181E. Battery Tester, Hydrometer Type. New non-clinging, non-breakable type. Convenient; eliminates the spilling of acid when making tests. The best and most practical tester on the market.....**$0.75**

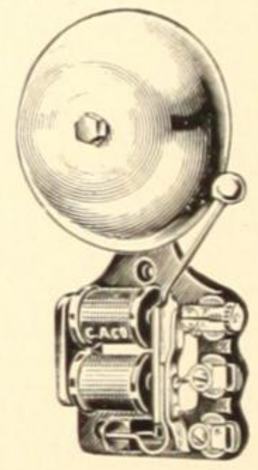
Bells, Electric



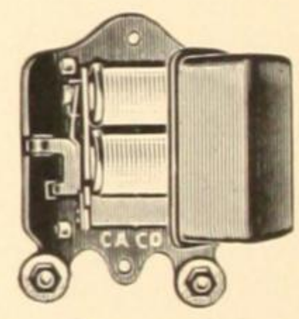
Nos. 183E-185E.



No. 186E.



Nos. 188E-190E.



No. 195E.

183E. Bells, Electric. Iron box, pivoted armature type. The cover is removable for inspection. Black japanned cover and base, nickel-plated gong. One cell of battery will operate either bell and as many as five bells may be used, if desired. May also be operated on a 110-volt A. C. circuit through a transformer.

Cat. No.	183E	185E
Diameter of gong, inches	2½	4
Each	**$0.65**	1.00

186E. Bell, Electric. Adjustable Screw Contact Type. The contact point is mounted in a screw which can be readily moved in or out, thus providing a simple means for regulating the action of the hammer. This adjustable feature is valuable in certain laboratory work. In the ordinary bell the contact point is fixed and hence cannot be adjusted except with extreme difficulty. Iron box, pivoted armature type, nickel plated 2½ inch gong, other metal parts black enameled. Cover removable for inspection. Operates on one cell or on 110-volt A. C. circuit through small transformer **$1.00**

188E. Bell, Electric, Skeleton Type. Pivoted armature, superior workmanship, nickel-plated gong, gives clear penetrating tone. For use on 6-volt battery circuits.

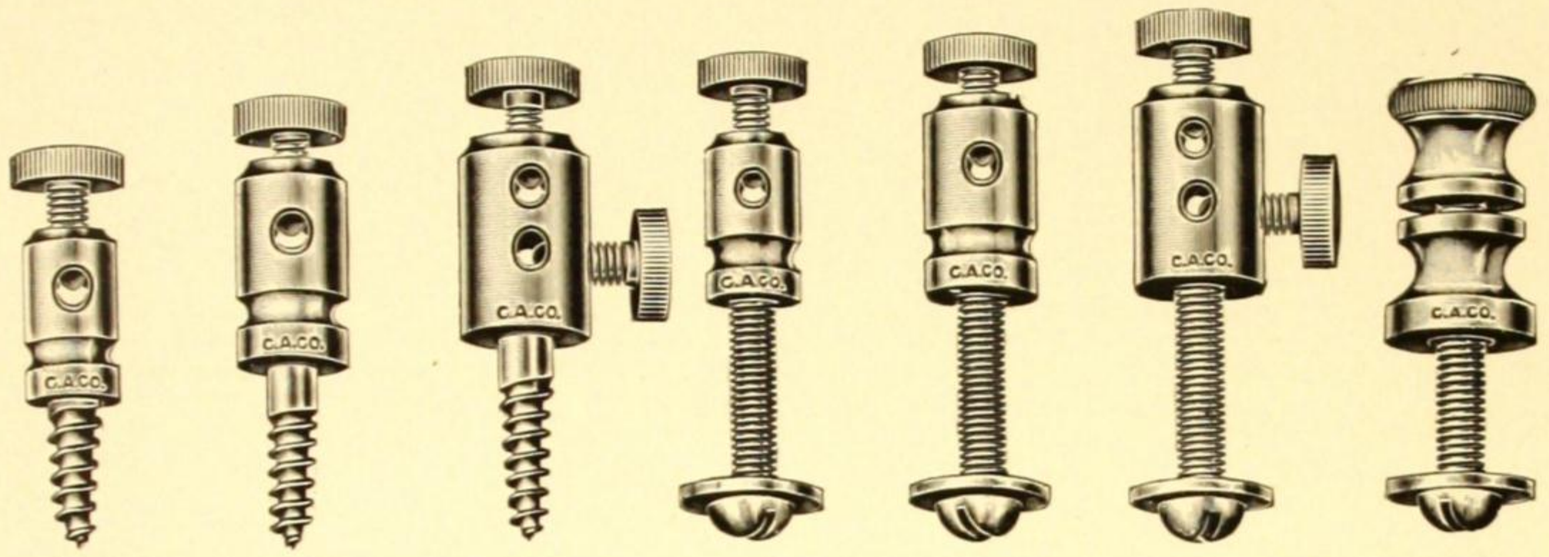
Cat. No.	188E	189E	190E
Diameter of gong, inches	4	6	8
Each	**$5.25**	**6.50**	**9.00**

192E. Bell Outfit, Electric. Consists of No. 183E Bell, Dry Cell, Push Button, 150 ft (1 lb.). Annunciator Wire, and Staples for putting up.....**$2.25**

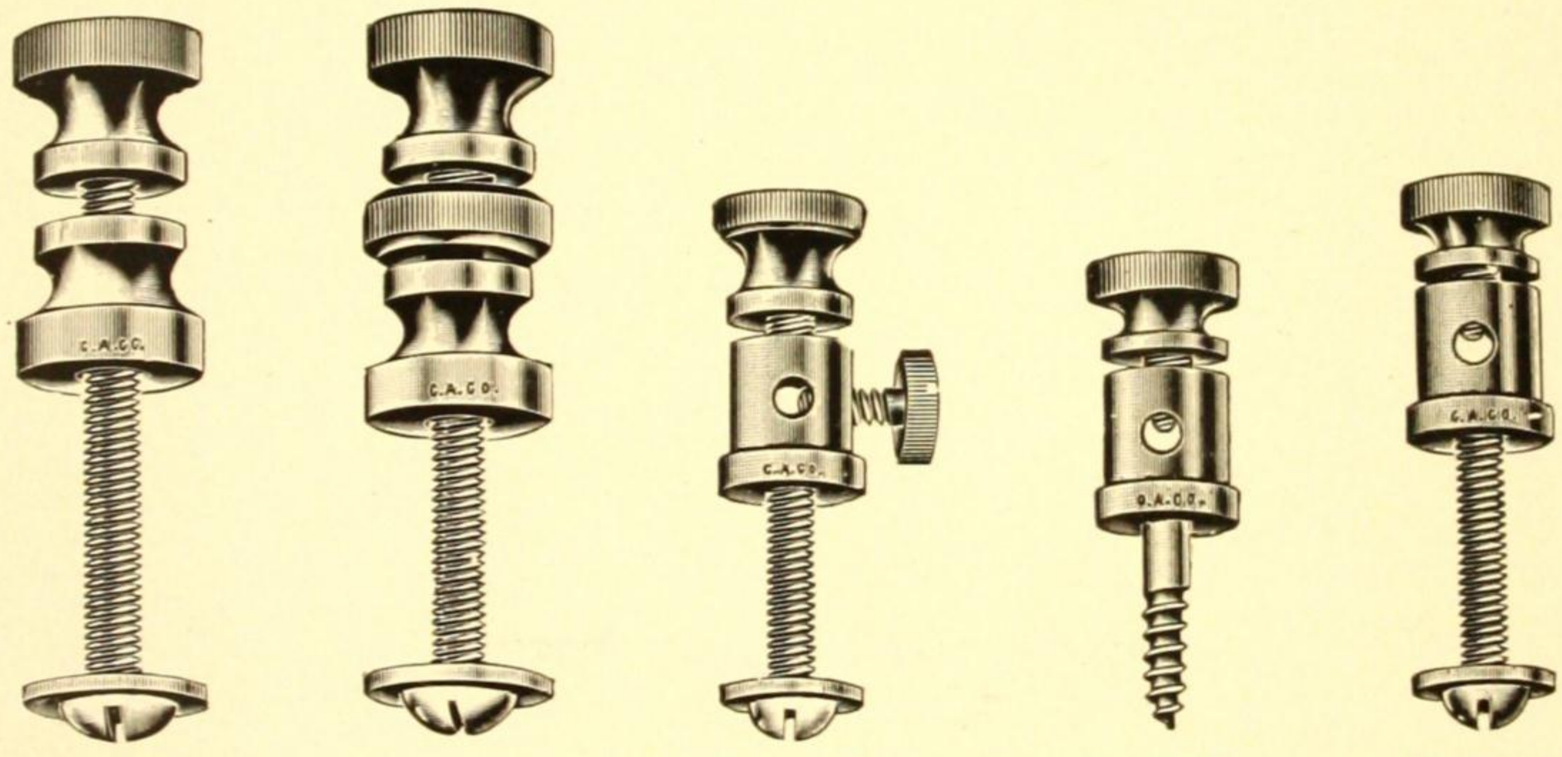
195E. Buzzer, Electric. Standard iron box type. **.60**

Binding Posts, Connectors, Terminals

Illustrations are full size.



No. 198E. No. 203E. No. 208E. No. 213E. No. 218E. No. 223E. No. 228E.



No. 233E. No. 238E. No. 248E. No. 253E. No. 258E.

198E. **Binding Post, Brass.** American form, with wood screw, small $0.15

203E. **Binding Post, Brass.** American form, with wood screw, large $0.18

208E. **Binding Post, Brass.** American form, with wood screw, double $0.25

213E. **Binding Post, Brass.** American form, with machine screw, small $0.12

218E. **Binding Post, Brass.** American form with machine screw, large $0.15

223E. **Binding Post, Brass.** American form, with machine screw, double $0.20

228E. **Binding Post, Brass.** English form, with machine screw, small $0.11

233E. **Binding Post, Brass.** English form, with machine screw, large $0.15

238E. **Binding Post, Brass.** English form, with machine screw, double $0.20

248E. **Binding Post, Brass.** English and American form combined, with machine screw $0.35

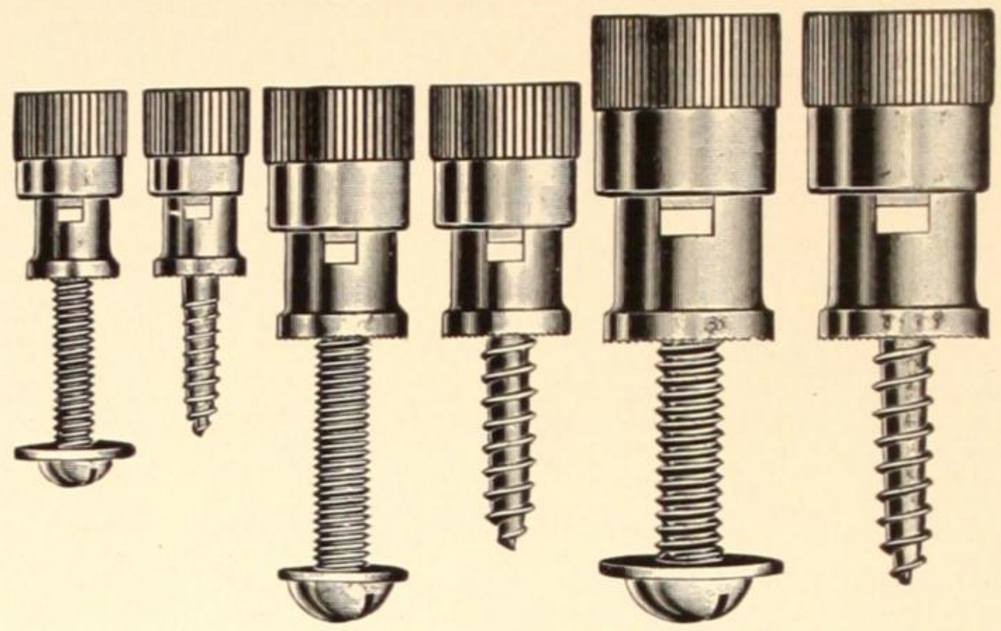
253E. **Binding Post, Brass.** English and American form combined, with wood screw $0.30

258E. **Binding Post, Brass.** English and American form combined, with machine screw $0.25

10% discount on above Binding Posts in lots of one dozen.

NEW LEADER BINDING POSTS

Illustrations are full size.



No. 263E. No.264E. No. 265E. No. 266E. No. 267E. No.268E.

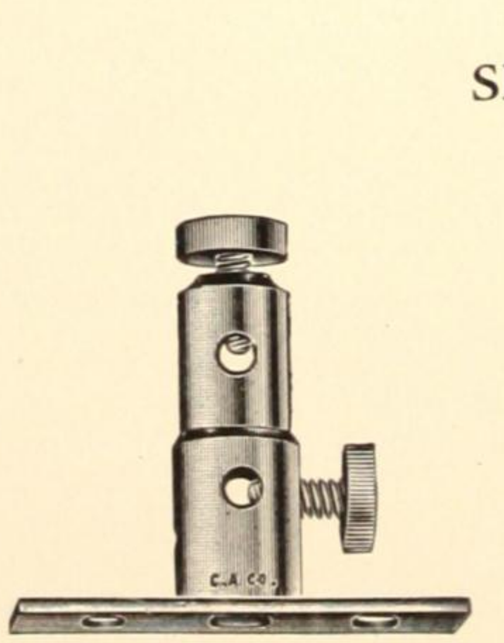
263E. Binding Posts, Brass, Leader. The above cuts, which are actual size, illustrate a new, novel patented binding post that possesses many advantages over all other forms. The contact surfaces extend the full width of the post and operate parallel to each other. They make perfect contact with even the smallest sizes of wire. The knurled knobs are not removable and therefore cannot become lost. These posts are dependable for accurate readings; they will not mar, owing to their vise-like grip, fine wires or terminals; they insure positive contact; their current-carrying capacity is 100% greater than other posts of equal size; extreme vibration will not loosen their grip.

Unquestionably the best binding posts on the market. Plain brass finish.

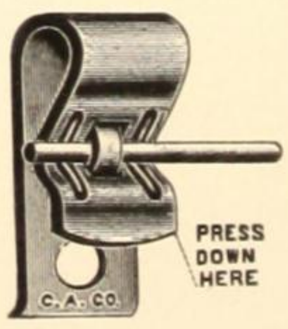
Cat. No.	263E	264E	265E	266E	267E	268E
Size	Small	Small	Medium	Medium	Large	Large
Kind of screw	Machine	Wood	Machine	Wood	Machine	Wood
Carrying cap., amperes	25	25	50	50	100	100
Each	**$0.18**	**.18**	**.20**	**$0.20**	**.45**	**.45**

SPRING BINDING POSTS

Illustrations are full size.



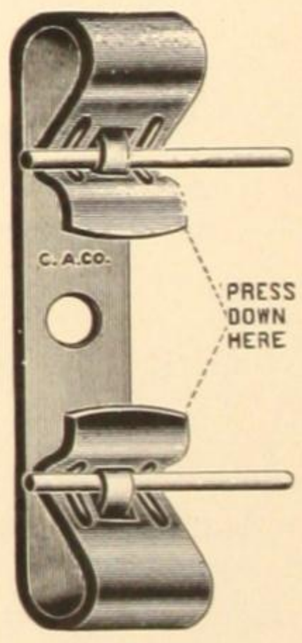
No. 269E.



No. 270E.



No. 271E.



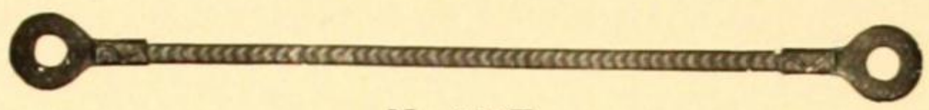
No. 272E.

269E. Binding Post, Brass, Plate. For wood screws, double **$0.55**

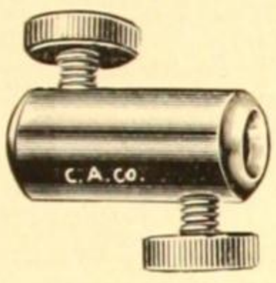
270E. Binding Post, Brass, Spring. Fahnestock patent. Takes any size wire up to 10 B. & S. gauge. For wood screw **$0.05**

271E. Binding Post, Brass, Spring. Same as No. 270E, but with a lug to which wire may be soldered **$0.06**

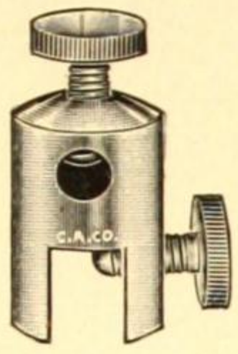
272E. Binding Post, Brass, Spring. Same as No. 270E, but double **$0.07**



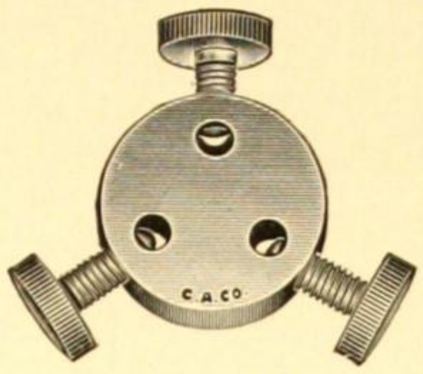
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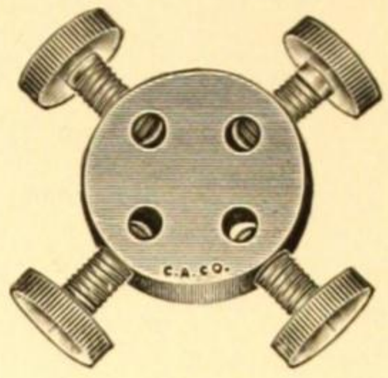
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No. 275E.



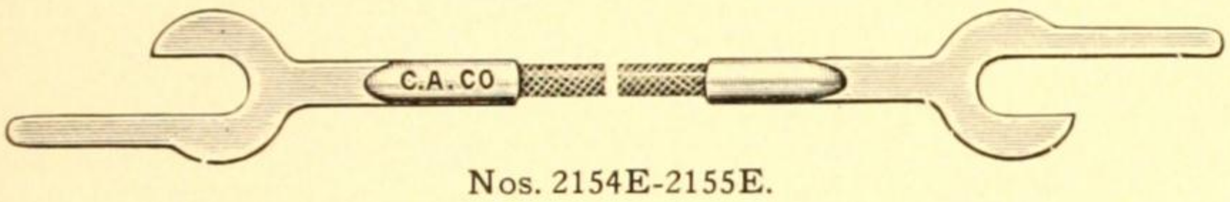
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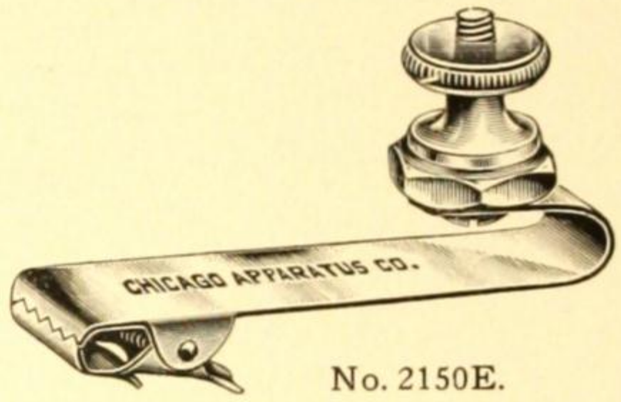
No. 277E.



No. 278E.



Nos. 2154E-2155E.



No. 2150E.

CONNECTORS

273E. Connector, Battery. Flexible conducting cord with copper terminals; length 5 inches.....**$0.06**

2150E. Connector, Clip. Convenient for holding small electrodes in electroplating and other work. Made entirely of nickel-plated metal. Designed to hang over edge of battery jar or tumbler.....**$0.25**

274E. Connector, Brass, Double. Both ends for wire **$0.12**

275E. Connector, Brass, Double. One end for wire, the other for plates or flat elements ¼ inch thick or less **$0.20**

276E. Connector, Brass, Triple. For wire..... .35

277E. Connector, Brass, Quadruple. For wire... .40

278E. Connector Cord, 36 Inches Long, with Tips. Flexible conducting cord with nickel-plated tip at each end **$0.45**

279E. Connector Tip. Nickel-plated and provided with knurled metal sleeve for locking the tip securely to the wire, insuring good contact without soldering. **Each** **$0.10**

2154E. Connecting Cords, with Universal Spade-Tip Terminals. For light currents. The cord is silk insulated flexible stranded copper wire equivalent to No. 18 B. & S. gauge. Terminals are soldered. Maximum carrying capacity for continuous service, 5 amperes; for short periods, 10 amperes.

No.	A	B	C	D
Length of cord, inches....	6	12	24	36
Each	**$0.25**	.28	.30	.35

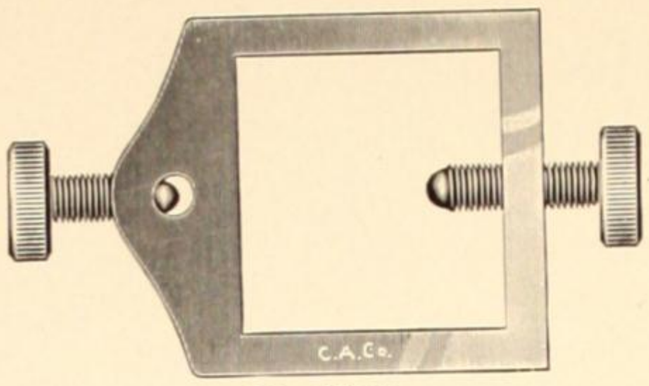
2155E. Connecting Cords, with Universal Spade-Tip Terminals. For heavy currents. The cord is rubber insulated flexible stranded copper wire equivalent to No. 12 B. & S. gauge. Terminals are soldered. Maximum carrying capacity for continuous service, 20 amperes; for short periods, 40 amperes.

No.	A	B	C	D
Length of cord, inches....	6	12	24	36
Each	**$0.35**	.40	.45	.50

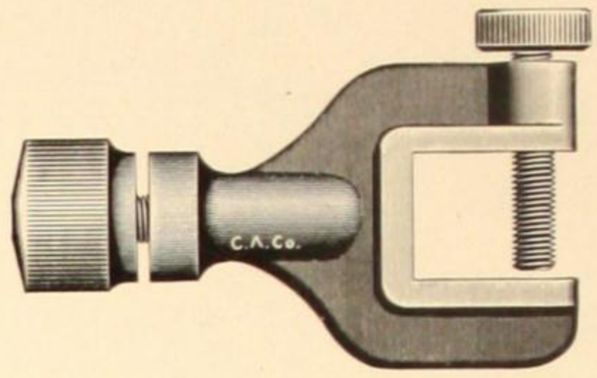
2156E. Cord, Stranded Copper Wire, with Silk Insulation. Same as used on No. 2154E. **Per yd...$0.10**

2157E. Cord, Stranded Copper Wire, with Rubber Insulation. Same as used on No. 2156E. **Per yd. $0.25**

282E. Universal Spade-Tip Terminals. Nickel-plated. Same as on Nos. 2154E and 2155E Cords. Will fit any style binding post—American, English or Fahnestock Spring type. **Each**.....**$0.05**



No. 283E.

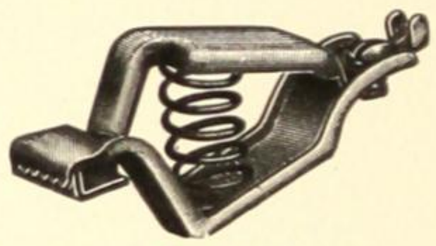


No. 284E.

283E. Connector, Carbon. For attaching to carbon elements up to ¾x¾ inches square, with clamping screw for lead-off wire.....**$0.30**

284E. Connector, Zinc. For attaching to zinc elements up to ⅜ inch thick, with binding post for lead-off wire **$0.30**

UNIVERSAL TEST CLIPS



No. 286E.

Strong toothed jaws and ample spring pressure establish perfect contact when clipped on to binding posts or wire. They save much time in work requiring quick temporary connections or rapid and frequent changes in connections. For this reason they are extensively used with laboratory test sets, factory testing devices, battery chargers, voltmeters, galvanometers, helices, transformers, etc. No. 287E is especially designed for storage battery work.

286E. Universal Test Clip. Cadmium plated, provided with binding post for attaching wire; spread of jaws, ⅞ inch; carrying capacity, 20 amperes.
Per 100.....**$15.00, each**.....**$0.20**

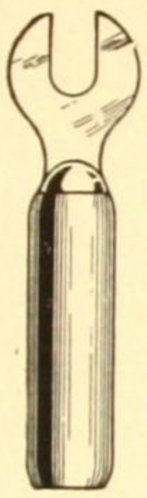
287E. Universal Test Clip. Same as No. 286E, but lead plated. This acid proof protection makes it more serviceable in storage battery work.
Per 100.....**$9.00, each**.....**$0.12**

288E. Insulator. Of soft rubber, designed to fit over Nos. 286E and 287E Test Clips. Covers the entire clip except the jaws.
Per 100.....**$9.00, each**.....**$0.12**

289E. Connector. Consists of 36 inches of 6 ampere capacity lamp cord with a No. 286E Test Clip at each end **$0.60**

Meliorate Easy-to-Attach Terminals

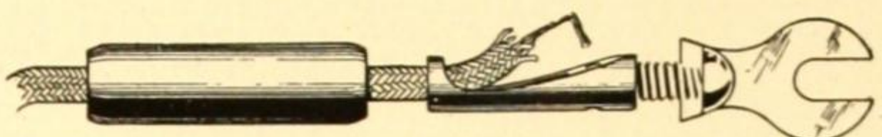
(Solderless Type)



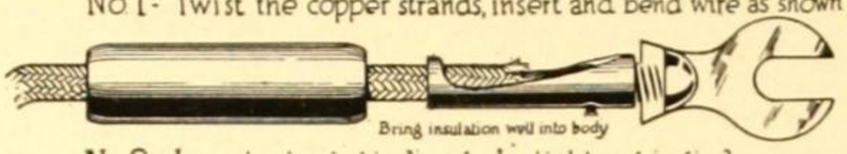
Nos. 290E5-8.



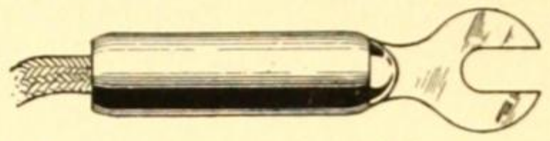
Nos. 290E9-12.



No 1 - Twist the copper strands, insert and bend wire as shown



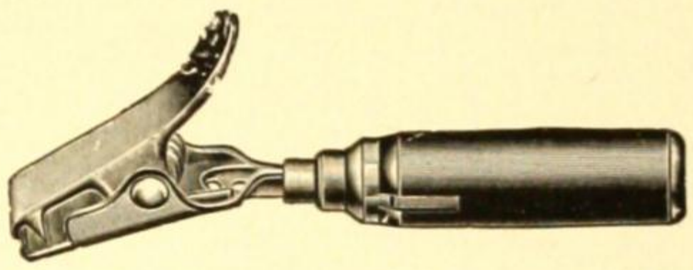
No 2 - Insert wire in binding hole, tighten binding screw



No 3 - Force sleeve into position



Nos. 290E13-16.



Nos. 290E21-22.

Consists firstly of a hollow metallic sleeve, or body, cylindrical in shape, for receiving the wire to be connected. The middle portion of this sleeve is cut open, so as to render the wire readily accessible after insertion into the sleeve. The end of the wire, after having been bent at right angles to its length, is inserted in a small hole which prevents it from slipping out. Against the end of the wire so bent, electrical contact is made by a threaded contact face resembling a winged nut, for the double purpose of connecting the wire, with the binding post of the instrument or apparatus in use and at the same time acting as a convenient handle for the screw.

A fibre sleeve slips over the metallic body and acts as an insulating handle and locking element to prevent removal of the wire.

The **mechanical construction** of the terminal combines simplicity, strength and durability.

The body is of hard drawn brass, accurately machined, so that the wire is positively protected from injury to the insulating covering by fraying or sliding back and forth.

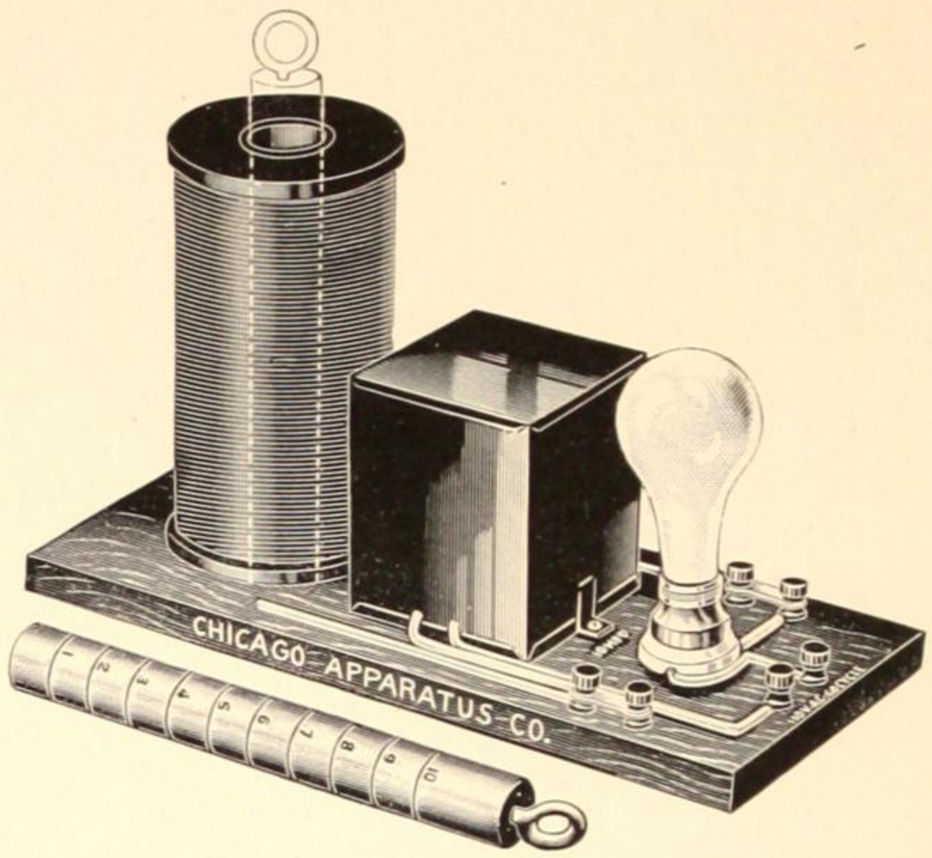
The sleeve is made of a hard, strongly dielectric material, and is moisture-proof and unaffected by temperature up to 180° Centigrade (324° Fahrenheit). It will not chip, crack or break, and can stand the hardest usage.

The contact faces are interchangeable, so that the wire need not be removed for different service, one lead sufficing.

For indicating polarity SOLDERLESS TERMINALS are supplied with either red or black sleeves. Made in two sizes. Size A, for No. 16 or 18 B. & S. gauge wire. Size B, for No. 14 B. & S. gauge wire.

Cat. No.	Type	Size	Sleeve	Each	Dozen
290E5	End Slot	A	Black	**$0.30**	**$3.00**
290E6	End Slot	A	Red	**.30**	**3.00**
290E7	End Slot	B	Black	**.40**	**4.00**
290E8	End Slot	B	Red	**.40**	**4.00**
290E9	Side Slot	A	Black	**.30**	**3.00**
290E10	Side Slot	A	Red	**.30**	**3.00**
290E11	Side Slot	B	Black	**.40**	**4.00**
290E12	Side Slot	B	Red	**.40**	**4.00**
290E13	With Tip	A	Black	**.30**	**3.00**
290E14	With Tip	A	Red	**.30**	**3.00**
290E15	With Tip	B	Black	**.40**	**4.00**
290E16	With Tip	B	Red	**.40**	**4.00**
290E21	Spring Clip	B	Black	**.50**	**5.00**
290E22	Spring Clip	B	Red	**.50**	**5.00**

BLACK'S CHOKE AND RESONANCE COIL



No. 291E.

291E. Choke and Resonance Coil, Black's. Designed for use in lecture and experimental work on impedance, reactance and resonance in alternating currents. Performance and electrical characteristics are in exact accordance with specifications furnished us by Prof. N. Henry Black, Jefferson Physical Laboratory, Harvard University, Cambridge, Mass.

The terminals of the coil, condenser, and lamp are brought out to separate binding posts. This permits their connection into circuit singly or in any combination. Also it permits the introduction of meters for the measurement of current flow through, and voltage across any portion of the circuit. Either D.C. or A.C. 110-volt current may be impressed on the terminals of coil, condenser or lamp, regardless of whether they are used singly or in combination.

This new apparatus makes possible the following interesting demonstrations:

1. Effect of Inductance in D.C. and A.C. Circuits. Connect coil only into a 110-volt D.C. circuit and then into a 110-volt, 60-cycle A.C. circuit, using ammeters in both cases to determine the current flow. With D.C. current passing through the coil the current flow is 10 amperes, whereas with A.C. it is only 1.5 amperes. This striking reduction in current flow—85%—is a fine illustration of the remarkable choking down of alternating current caused by the inductance of the coil only (without iron core).

2. Lamp in Series with Inductance in D.C. and A.C. Circuits. Insert a 300-watt, 110-volt lamp in the socket. Connect lamp and coil in series into a 110-volt D.C. circuit and then into a 110-volt, 60-cycle A.C. circuit. With D.C. current the lamp burns brightly, while with A.C. current the lamp filament barely glows, a visual demonstration of the choking effect of inductance in A.C. circuits. If ammeters are employed to check the current flow, they will show that on D.C. the current flow is 2.4 amperes and on A.C. 1.0 ampere.

3. Effect of Iron Core on Coil Reactance. Insert a 100-watt, 110-volt lamp in the socket. Connect coil and lamp in series in a 110-volt D.C. circuit. The lamp burns brightly. Insert the iron core inside the coil. The brilliancy of the lamp is not diminished. Now, connect the coil and lamp into a 110-volt, 60-cycle A. C. circuit. The lamp burns brightly as before. Slowly lower the iron core inside the coil. As it descends, the lamp gradually loses its brilliance and finally goes out. An A.C. Ammeter will show a current flow of .79 ampere before the insertion of the iron core, and of only .20 ampere when it is fully inserted. The enormous intensification of the choke effect by the presence of the iron core in the coil is most strikingly exhibited in this demonstration, and is due to the increase in coil reactance, which raises the impedance in the circuit from 142.4 to 562.5 ohms. Dimmers in theatres used to produce stage lighting effects operate on this iron-core-choke principle.

4. Effect of Condenser in D.C. and A.C. Circuits. Connect the condenser and ammeter first in a 110-volt D.C. circuit and then in a 110-volt, 60-cycle A.C. circuit. In the D.C. circuit no current flows, as the absence of deflection shows. However, in the A.C. circuit, the ammeter shows a current flow of .42

ampere through the condenser. Calculation by employing the usual formula shows that the capacity of a condenser passing .42 ampere on 110-volt, 60-cycle A.C. current is about 10 microfarads. By connecting the condenser and a 100-watt lamp into D.C. and A.C. circuits as explained above it can be visually demonstrated that D.C. current is blocked by a condenser and that A.C. current passes through. This principle makes possible the use of condensers in radio work for filtering out undesirable D.C. currents and for by-passing A.C. currents without shorting D.C. circuits.

5. Condition of Resonance in an A.C. Circuit. The reactance of a choke coil in an A.C. circuit tends to make the current lag behind the voltage, while the reactance of a condenser has just the opposite effect—it tends to make the current lead the voltage. If the reactance of the coil is adjusted to balance out the reactance of the condenser, or vice versa, the impedance is reduced to the bare resistance of the circuit and under this condition the maximum current flows through it. This condition of resonance is of great importance in radio circuits, for it is by establishing such condition—known as the process of tuning—that the energy sent out by broadcast stations is provided a path of least resistance through the modern radio receiving set. This condition of resonance can be effectively and visually demonstrated with this new apparatus as follows: Connect the coil, condenser and lamp in series in a 110-volt, 60-cycle A.C. circuit. Note that the lamp burns considerably below its normal brilliance. Now, insert the iron core inside the coil and gradually lower it to the 4-inch mark. At this point—the condition of resonance—it burns at maximum brilliance. As the core is lowered further the lamp becomes dimmer, and at the 10-inch mark, almost ceases to glow. If an ammeter is inserted in the circuit it will read .54 ampere with the core at the 0-mark, .67 ampere at the 4-inch mark, and .32 ampere at the 10-inch mark; the corresponding impedances of the circuit being 208.3, 167.9 and 351.6 ohms.

The following results, obtained on 112.5-volt, 60-cycle A.C. circuit by direct meter measurements, indicate the practicability of this apparatus in quantitative experimental work.

	Coil Only			Coil in series with 100-Watt Lamp		Coil, Condenser and 100-Watt Lamp in Series	
Iron Core Inserted to Inch Mark	Current Flow in Amperes	Impedance in Ohms	Inductance in Millihenries	Current Flow in Amperes	Impedance in Ohms	Current Flow in Amperes	Impedance in Ohms
0	1.50	75.0	196	.790	142.4	.54	208.3
1	1.40	80.4	211	.765	147.0	.55	204.6
2	1.10	102.3	245	.722	155.8	.59	190.7
3	.84	133.9	354	.630	178.6	.64	172.6
4	.64	175.8	466	.525	214.3	.67*	167.9*
5	.48	234.3	621	.425	269.4	.66	170.5
6	.38	296.0	785	.350	321.4	.605	186.0
7	.30	375.0	995	.290	388.0	.51	220.6
8	.25	450.0	1193	.245	459.2	.425	245.9
9	.20	562.5	1492	.200	562.5	.35	321.4
10	.20	562.5	1492	.200	562.5	.32	351.6

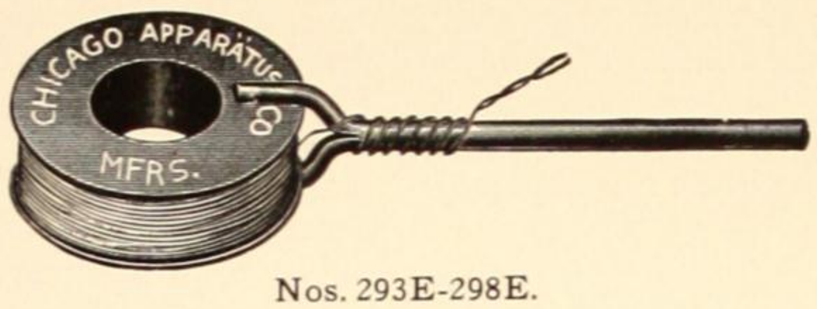
* Condition of Resonance.

Specifications

The coil is wound on a heavy fiber tube with extra thick fiber ends and contains approximately 3,000 turns of heavy gauge insulated copper wire. The condenser has a capacity of about 10 microfarads and is inclosed in a sealed metal case finished in black enamel. The lamp is a standard 110-volt, 100-watt tungsten filament type, mounted in a standard socket. Coil, condenser and lamp are provided with separate binding post terminals, so that they may be connected into circuit singly or in combination, and so that voltmeters and ammeters for measuring the entire circuit or any part thereof may be readily introduced. The core is $1\frac{7}{16}$ in diameter by 12 inches long, and is graduated from 0 to 10 inches. The apparatus is mounted on a finely finished hardwood base, 22.5 x 45 cm. Complete, as illustrated, with iron core and 100-watt lamp.....**$60.00**

292E. Incandescent Lamp, 300-watt, 110-volt. Standard Edison base, fits socket of No. 291E. For use in Experiment No. 2, described above.....**$2.00**

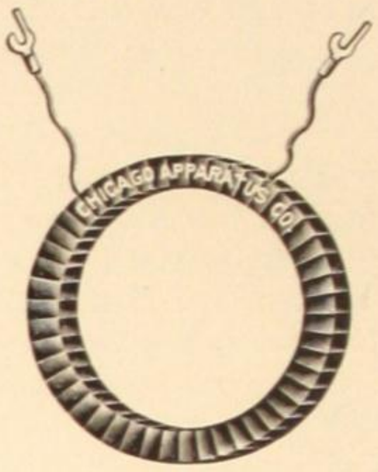
For experiments using the above apparatus, see pages 410-413, "Practical Physics," by Black and Davis, and Exp. No. 51, "Laboratory Experiments in Practical Physics," by N. Henry Black.



Nos. 293E-298E.



Nos. 303E-308E.



No. 310E.

293E. Coil for Induction. As used in Millikan, Gale and Bishop's Course in the study of induced currents, induction of currents by bar magnets, induction of currents by electro-magnets, and principles of the dynamo and motor. Consists of a metal spool, 63 mm. in diameter, wound with 600 turns of No. 28 insulated copper wire, and provided with 10 cm. handle. Hole in center is large enough for 19x6 mm. bar magnet (No. 18M).....**$0.75**

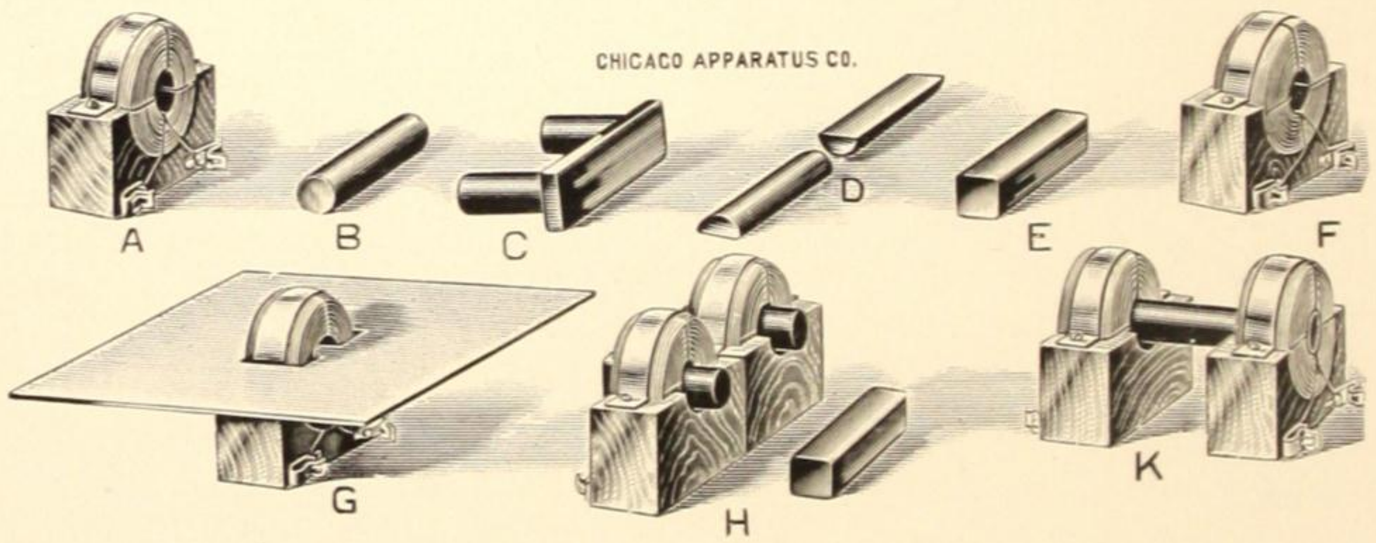
298E. Coil for Induction. Similar to No. 293E, but with spool 38 mm. diameter and hole in center for 10x10 mm. bar magnet (No. 14M).....**$0.65**

303E. Coil for Induction, Primary. As used in Linebarger's Course. Consists of 100 turns of No. 20 insulated copper wire, form wound, inside diameter, 30 mm. Fits into Coil No. 308E.....**$0.75**

308E. Coil for Induction, Secondary. As used in Linebarger's Course. Consists of 500 turns of No. 30 insulated copper wire, form wound, inside diameter, 48 mm. Fits over Coil No. 303E.....**$1.00**

310E. Coil for Induction. Form wound coil, 25 cm. diameter, approximately 600 turns. No. 20 insulated copper wire with flexible leads and connectors. When connected in series with our No. 533E Lecture Table Galvanometer or other sensitive Galvanometer the effect of the earth's magnetic field and other induction phenomena may be made. As two of these coils are required in many experiments on induced currents we recommend the purchase of a pair of them .....**Each $7.50**

Gilley Coils



Nos. 311E1-311E7.

311E1. Coils for Induction, Gilley Type. Complete outfit. Especially valuable for student's use in the study of electro-magnetism, self and mutual induction, transformer principles, induced currents, etc. Figure G above shows how the slotted card boards are used in plotting the field about the coil by the compass method. Figure K, the arrangement of the coils and core for the study of transformer principles. Figure H, the coils and "U" shaped core in the study of electro-magnets. The coils are form wound, shellacked and baked, and mounted on supports with binding post terminals. The complete outfit includes 1 pair of coils, 1 "U" shaped core, 1 square armature, 1 round core, 2 half-round cores, and 2 slotted card boards, as described below..**$3.50**

311E2. Coils for Induction, Gilley Type. (Figs. A-F above) .....**Per pair $2.50**

311E3. Square Armature. (Fig. E above.).....**$0.15**

311E4. Core, "U" Shaped, Soft Iron. (Fig. C above.) For use in the study of bipolar electro-magnets.**$0.35**

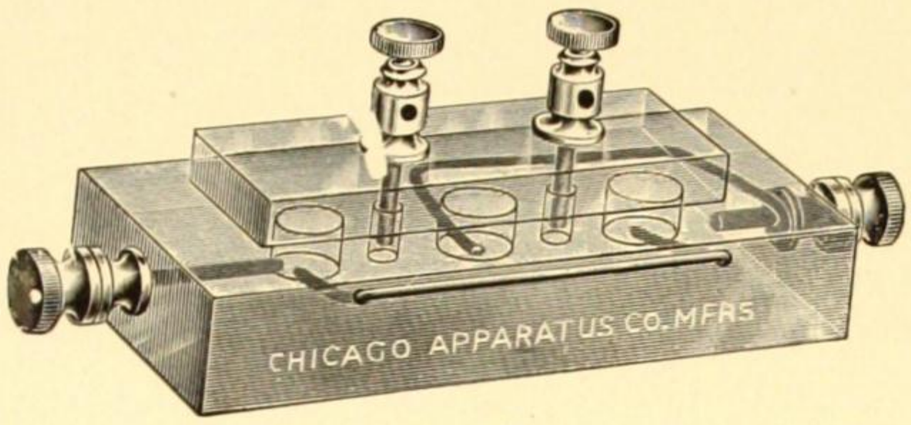
311E5. Core, Round, Soft Iron. (Fig. B above.) For use in the study of currents induced by electro-magnetism **$0.15**

311E6. Cores, Half-Round, Soft Iron. (Fig. D above.) For mapping lines of force.....**Per pair $0.20**

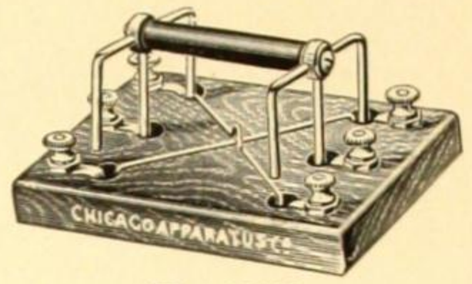
311E7. Slotted Card Boards. (Fig. G above.) For mapping lines of force.....**Per pair $0.10**



No. 313E.



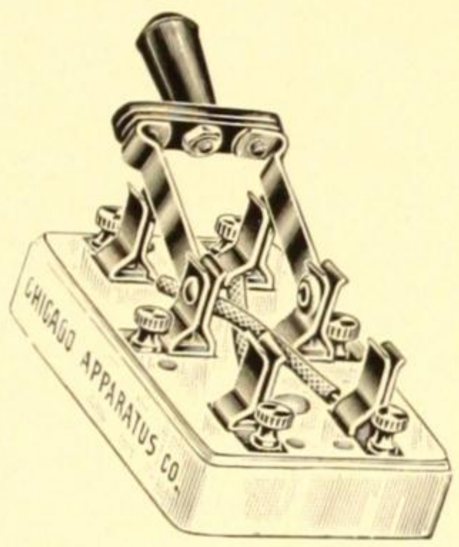
No. 318E.



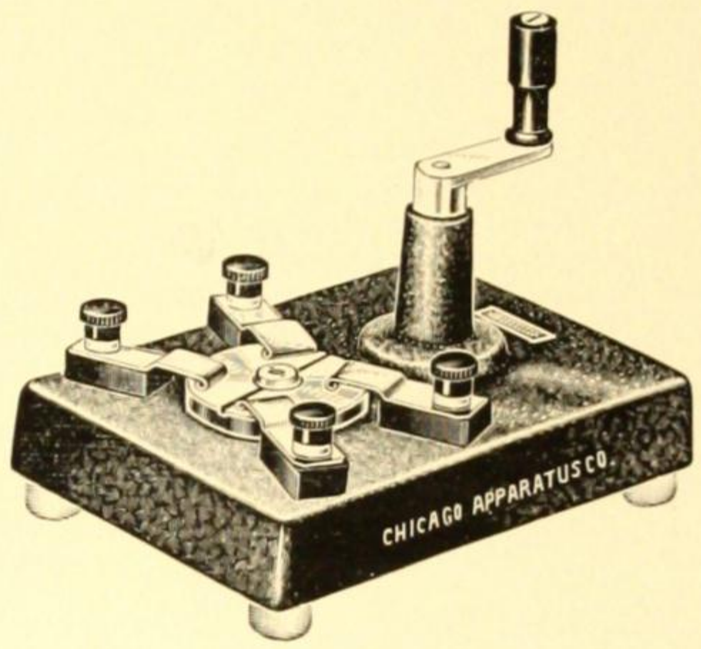
No. 320E.



No. 328E.



No. 338E.



No. 340E.

313E. **Color Top, Electric.** Will run at high speed for hours. Four color disks are furnished. When the top is at rest, the current is automatically shut off—no danger to the battery from this cause. It may be used equally well as a motor, and small mechanical toys may be operated by a belt from the grooved pulley on shaft. Runs efficiently on one cell, dry or other battery. Finished in red enamel; polished nickel trimmings..... **$1.75**

318E. **Commutator, Mercury, Three-Cup Type.** For reversing the direction of the current in an electrical circuit. May also be used as a contact key. Consists of a porcelain base, in which there are three mercury cups connected with two binding posts; and a fiber top with two steel projections and two binding posts. The action of the commutator is made clear by the above phantom cut. Having fewer mercury cups and cups of smaller size, this commutator requires much less mercury than the older forms. Size, 5x14 cm. **$1.50**

320E. **Commutator, Mercury, Pohl's.** One of the oldest and most popular forms of pole changers. Rapid and convenient. On 10x15 cm. hardwood base. **$3.50**

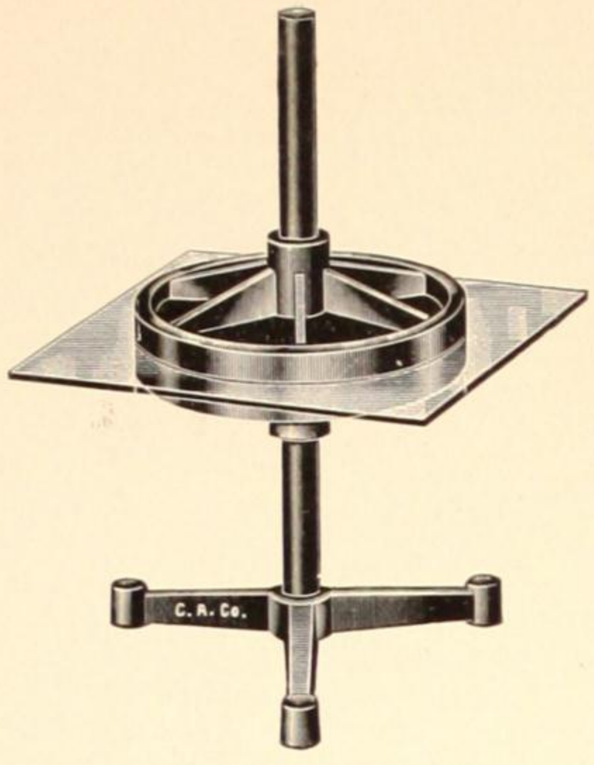
328E. **Commutator, Split Ring Type.** Consists of a split metal ring with handle, mounted on a 10x15 cm. polished wood base. Four phosphor bronze springs make contact with this ring, two with each segment. When this ring is turned through an angle of 90° it causes commutation. Complete with binding posts **$3.00**

338E. **Commutator, Switch Form.** New model provided with six binding posts. Can be connected into circuit more easily than the older models without binding posts. Mounted on porcelain base, carrying capacity 15 amperes **$1.25**

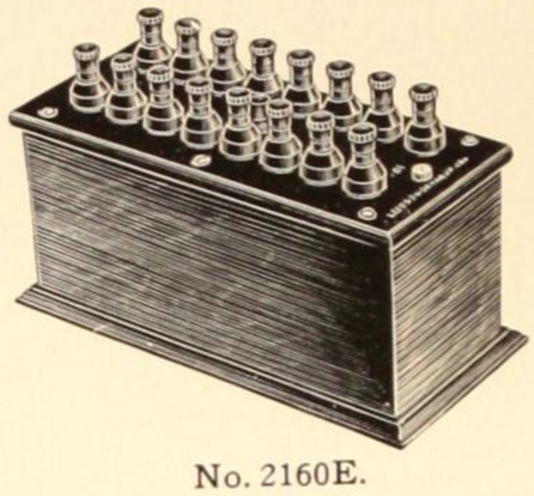
340E. **Commutator, Rotary, MILVAY—Improved Design.** For the complete demagnetization of test samples of iron and steel in magnetization and hysteresis experiments. This commutator is for connection into a test coil circuit through which a battery current (D.C.) is flowing, as outlined in Millikan and Mill's Experiment No. 15. By moving the crank of the commutator the direction of the current is made to undergo a series of rapid alternations. If at the same time the current is gradually decreased to zero, the residual magnetism of the test sample inside of the coil will also be reduced to zero with no predisposition toward a magnetization in any one direction other than that of the magnetizing force.

Positive self-cleaning brush contacts, high commutator speed at ordinary crank speed through easy-working gears, and massive yet simple construction, characterize this Milvay product.

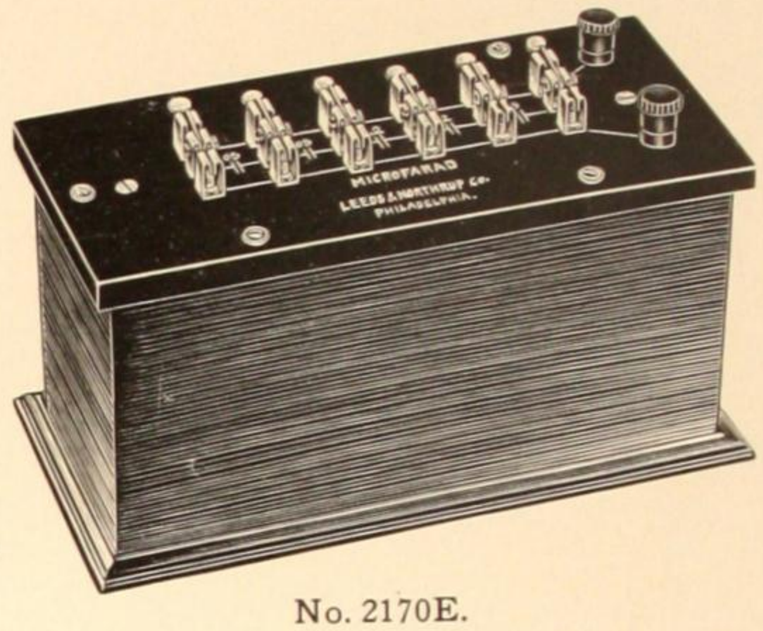
The base, 12.5x17.5 cm., is of cast iron with crystal black finish. The brass parts, except commutator face, are nickel-plated. The gear mechanism in the base is exposed for easy oiling and inspection. **$45.00**



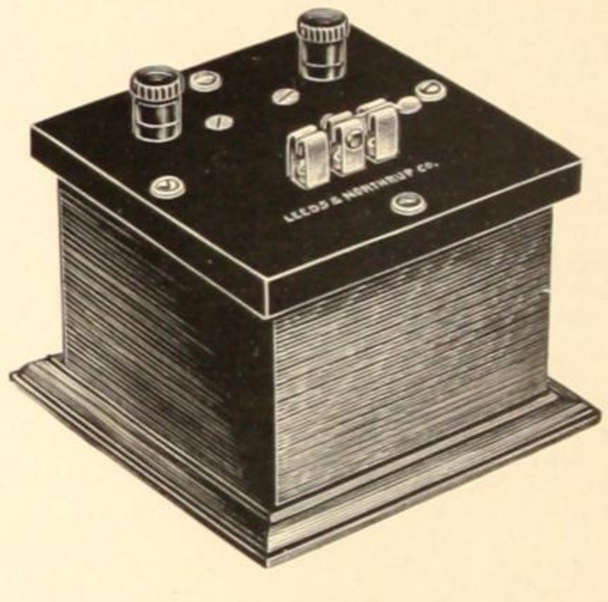
No. 345E.



No. 2160E.



No. 2170E.



No. 2180E.

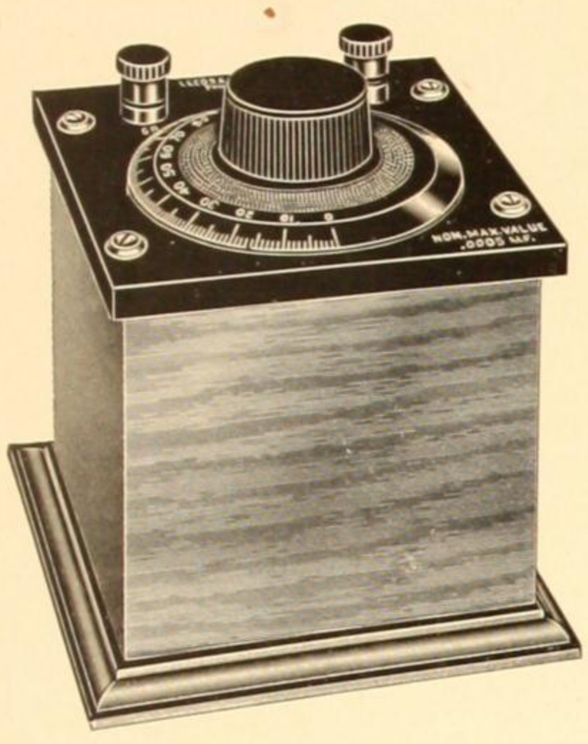
345E. Condenser, Experimental, Milvay. For determining the constants of mica, air, and other dielectrics as outlined in Experiment No. 9 in Millikan and Mill's "Electricity, Sound, and Light." The face of each of the two heavy brass plates is ground to a true plane. Thus they constitute a perfect parallel-plate condenser yielding results free from errors due to surface irregularities. Both are perfect circles and alike in diameter so that the radius—which must be taken into account when calculating the capacity—can be readily and accurately measured. The plates are approximately 15 cm. in diameter and each is provided with a binding post for convenience in making connections. The lower plate is mounted on an insulating pillar supported in a suitable tripod base, while the upper plate is provided with an insulating handle. A thin smooth sheet of mica is included **$15.00**

346E. Extra Mica Plate. For No. 345E for replacement **$1.50**

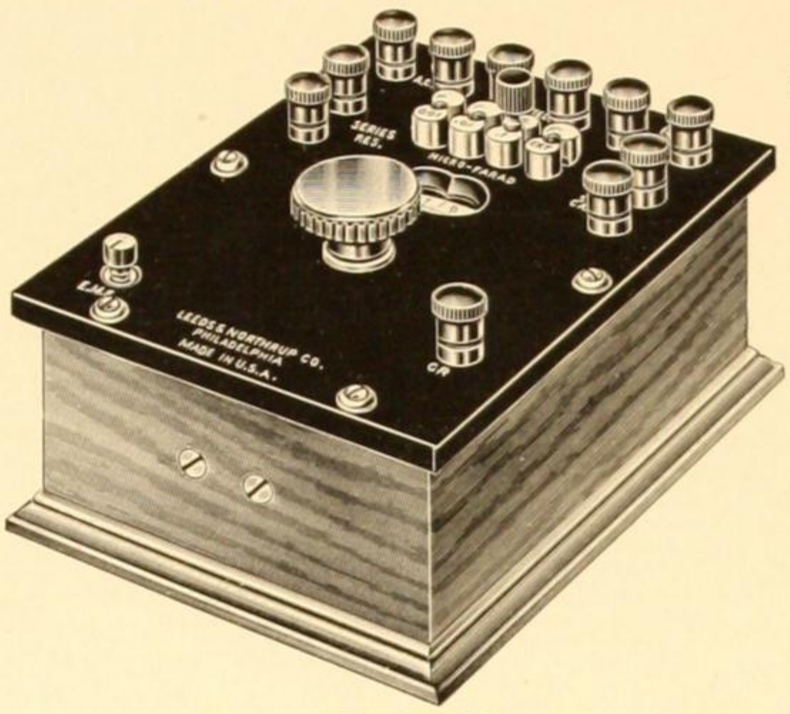
2160E. Condenser, Mica Precision Standard, L. & N. This design was worked out in consultation with the Bureau of Standards to secure characteristics which should meet the most exacting requirements. Each section is sent to the Bureau of Standards before it is assembled in the instrument. Only sections which receive a satisfactory certification are used. After the sections are assembled, the whole condenser is sent to the Bureau of Standards for a re-certification of the sections. Each pair of condenser terminals is connected to small binding posts mounted on hard rubber insulating pillars of petticoat construction. The insulation thus secured is very high, and there is a minimum of capacitance between the metal parts and connections. Total capacity, 1 microfarad subdivided into eight sections: 0.5, 0.2, 0.1, 0.1, .05, .02, .02, and .01 microfarad. All sections adjusted within ¼%; values given to .1% in Bureau of Standards Certificate accompanying each instrument. Phase angle, of any section at 20° C., will not exceed 2′. Actual phase angles given to 10″ in certificate. Assembled on polished hard rubber top plate mounted in polished mahogany case with cover, the latter not shown in cut **$200.00**

2170E. Condenser, Standard Mica, L. & N. Provides a total capacitance of 1 microfarad, subdivided into five sections. By means of switches the sections may be connected in various series and multiple combinations. The use of knife switches instead of plugs results in several advantages: No plugs to become lost or mislaid—smaller metal surfaces more widely separated, reducing errors due to stray capacitance—increased insulation—easier to clean—less crowding and more detail in diagram on the hard rubber top. This condenser continues to be popular in educational laboratories where an accurate subdivided standard of capacitance is required. Subdivided in 5 sections as follows: 0.5, 0.2, 0.2, 0.05, 0.05 microfarad. Assembled on polished hard rubber top plate and mounted in polished mahogany case with cover. Accuracy for all sections, ¼% **$65.00**

2180E. Condenser, Standard Mica, L. & N. Same general design as No. 2170E, but has only one section, of 0.5 microfarad. Equipped with circuit opening and discharge switch. Assembled on polished hard rubber top plate and mounted in polished mahogany case with cover. Accuracy, ¼% **$30.00**



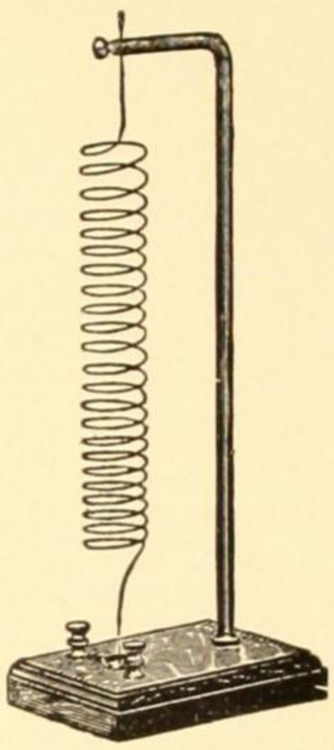
No. 2190E.



No. 2200E.



No. 2205E.



No. 378E.

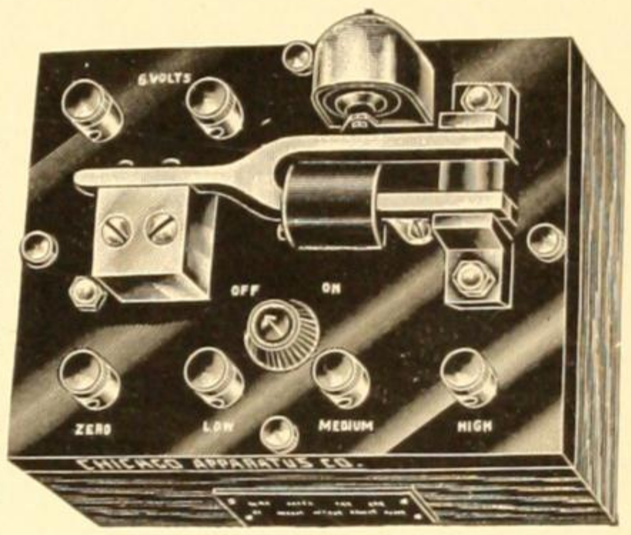
2190E. Condenser, Adjustable Air, L. & N. Substantially constructed and designed to have low dielectric loss. Mounted in shielded mahogany case with hard rubber top plate. Range 20 to 1000 micro-microfarads, approximately; scale divided in uniform parts 0 to 100, furnished with L. & N. certificate giving true value at each 10 divisions. A fine condenser, useful in physical and electrical laboratories as a secondary standard **$30.00**

2200E. Farad Bridge, L. & N. Affords a simple means for comparing an unknown capacitance with that of a self-contained standard condenser. When using the .1 and .01 microfarad built-in standards, an accuracy between 1 and 2% is obtained in the range from .003 to .3 microfarad. From .3 to 1 microfarad the accuracy is 3% or better. Using the .001 standard, measurements between .0003 and .003 microfarad can be made with an accuracy of 3% or better, and an accuracy of 10% is obtainable down to .001 microfarad. In all cases the standard should be selected that will keep the reading as near as possible to the center of the scale. The No. 2170E 1-microfarad standard mica condenser may be connected externally to extend the range or to increase the accuracy of the higher readings. It is also convenient for checking the internal standards. The No. 2210E microphone hummer provides a satisfactory source of 1000 cycle current for use with this bridge. Contains 3 standard mica condensers—.001, .01, .1 microfarad. Assembled on polished hard rubber plate and mounted in polished mahogany box with cover, the latter not shown in illustration **$80.00**

2203E. Condenser, Paper. About 1 microfarad, size 11x5x2 cm. Will stand 120 volts..... **$1.50**

2204E. Condenser, Paper. About 2 microfarads, size 12x5x2 cm. Will stand 120 volts..... **$1.50**

2205E. Condenser, Paper. Two No. 2203E Condensers in finely finished hardwood case with bakelite top. Their terminals are brought out to three external binding posts so that the condensers can be used or measured singly, in series or parallel..**$5.00**

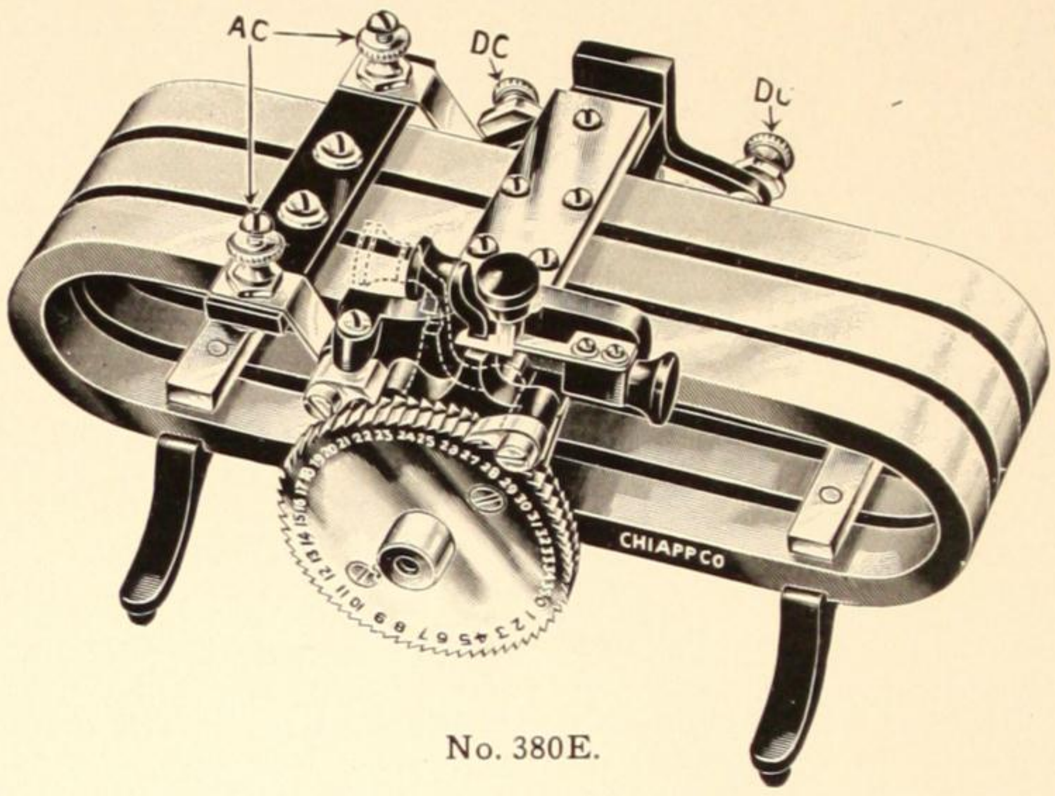


No. 2210E.

2210E. Audio Oscillator or Microphone Hummer. Provides a dependable source of constant frequency alternating current of low power for bridge measurements and other laboratory work. Simple, rugged and reliable. Output, about 0.06 watt at 1000 cycles. Three output voltages are obtained—.5 volts, current 100 milliamperes—1.5 volts, current 40 milliamperes—5 volts, current 12 milliamperes. Operates satisfactorily on 4 to 8 volts. Input current, about 0.13 ampere. By using an inductance and capacitance, voltages as high as 50 and 100 are obtainable. The tuning fork insures a constant frequency of 1000 cycles. Requires no adjustment and operates continuously without heating. Self-starting—may be operated at a distance by a key or switch. Well adapted for the usual alternating current measurements of inductance and capacitance. Mounted in polished walnut box with engraved bakelite panel. Metal parts finished in polished nickel. Provided with lock button control switch. Size 6x4¾x5 inches **$32.00**

378E. Contracting Helix. Improved form. A battery current traversing the spiral causes the helix to contract, due to the attraction of successive turns. This will raise the lower end of the spiral out of the mercury, break the circuit, and allow the spiral to return to its normal length. Then the spiral will lengthen, its lower end will again touch the mercury, and the action will be repeated. This apparatus is about 35 cm. high. Without mercury..... **$2.75**

MILVAY DYNAMO ANALYSIS APPARATUS



No. 380E.

380E. Dynamo Analysis Apparatus, Milvay, New A.C.-D.C. Model. For use in conjunction with a ballistic galvanometer like our No. 2285E for obtaining data which when plotted will show that the curve of the induced E. M. F. of a simple or ideal dynamo is a sine curve.

Long experience with former models of this apparatus has demonstrated that the plotted curve will be a smooth sine curve only when every successive rotation of the coil is an exact 10-degree interval and every successive rotation is at the same angular velocity. Without this interval and velocity uniformity, the result will always be a "saw-tooth" curve. The mechanical improvements incorporated in the new Milvay model have been designed to secure this absolutely necessary interval and velocity uniformity.

Interval uniformity is obtained by a new escapement and escapement wheel having two sets of teeth projecting in opposite directions. Two pawls engage these sets of teeth. The right hand pawl, under spring tension when set, causes coil rotation when the trigger is released by depressing the middle hard rubber button. The left hand pawl engages the inner row of teeth and brings the coil to rest at the end of its 10-degree excursions.

Velocity uniformity is obtained by employing a straight flat spring, the tension of which is automatically set for each interval in moving the right hand pawl under the trigger. This construction insures unvarying tension. In older models a long coiled spring is employed, the tension of which decreases as it unwinds. In addition to the important advantage of interval and velocity uniformity, so absolutely necessary to obtain smooth curves, the entire escapement mechanism is more sturdy in construction; thus a lifetime of highly satisfactory service is assured.

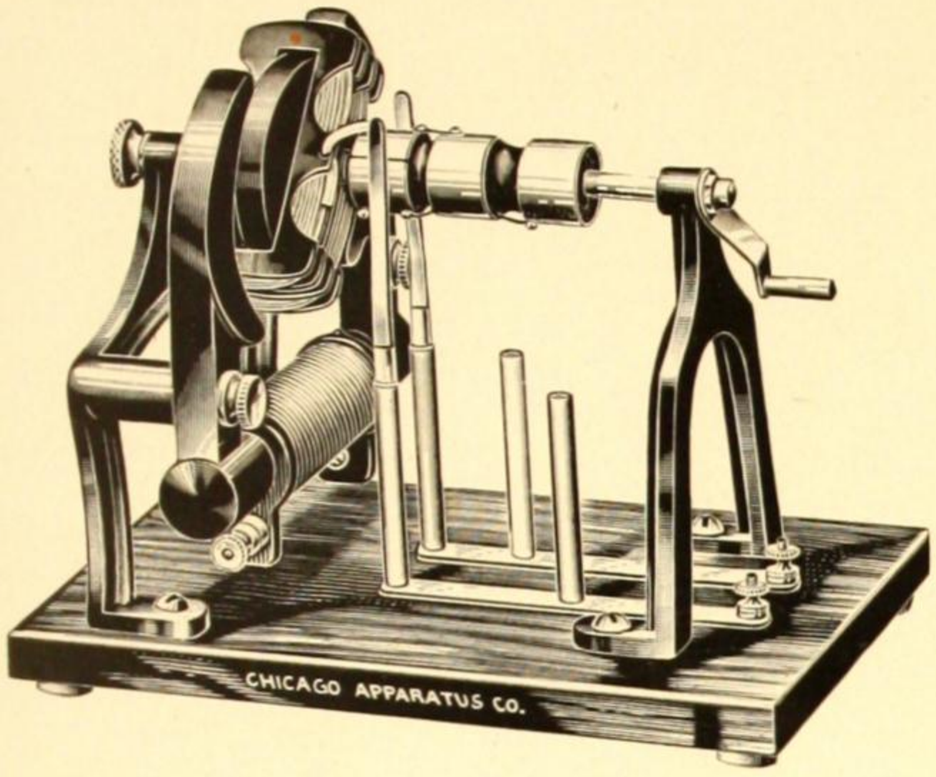
Furthermore, greater ease and comfort of operation are provided. Instead of shifting a lever, it is only necessary to depress a button to release the coil, the operation being no different than depressing a contact key. Another important feature is the addition of the split ring commutator, which provides means for gathering data for plotting the induced E. M. F. of a D.C. dynamo as well as of an A.C. machine.

Still another valuable feature is the fact that the escapement mechanism can be instantly set to operate any desired 10-degree interval, a great convenience should it be found necessary to recheck the deflection for one or more intervals because the galvanometer suffered disturbance or because its coil was in motion when the first readings were taken.

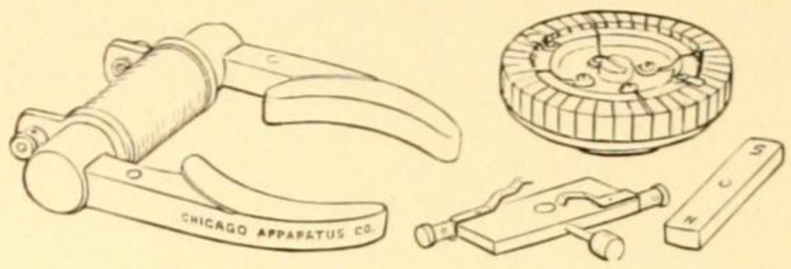
With the lever escapement mechanism in older models any desired interval can only be reached after a series of successive releases—a slow and tedious process—whereas in the new Milvay model the desired interval can be reached directly by simply turning the ratchet wheel to the desired point without once releasing the escapement mechanism.

As illustrated, the apparatus consists of two sets of three magnets mounted with their like poles adjacent so that a strong and practically uniform magnetic field is produced between the pole pieces fastened to the two sets of poles. Between these poles a long rectangular coil is so mounted that it can be rotated in exact 10-degree steps and at uniform velocity through 360 degrees at an axis perpendicular to the direction of the magnetic field.

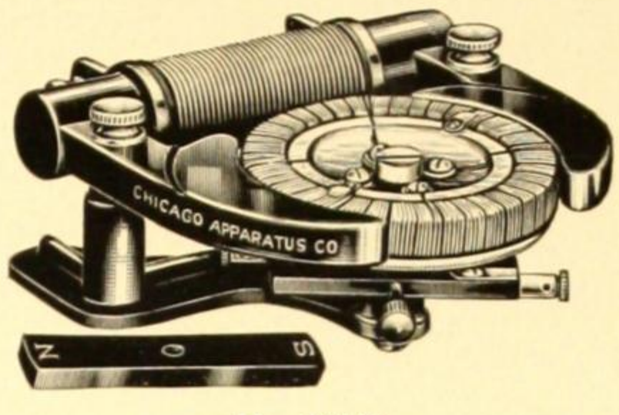
Because of the precise results, convenience of operation, sturdiness of construction, excellence of workmanship, elegance of finish, and the addition of a D.C. split ring commutator, this new Milvay instrument commends itself to the most exacting science teacher **$50.00**



No. 386E.



No. 387E. (Dissected).



No. 387E.

386E. Simple Dynamo Electric Machine. (Built after design by Prof. Miller and Prof. Cowan, of the Boston, Mass., schools.) For effectively demonstrating: Alternating Currents, Direct Currents, Commutator Action, Effect of Speed, Separately and Self-Excited Dynamos, Alternators, Direct Current Generators, and Series, Shunt and Compound Dynamos and Motors as outlined on pages 524 to 546 of Fuller, Brownlee and Baker's "Elementary Principles of Physics." Two dry cells serve to excite the field while a portable galvanometer, like our No. 574E, is best for indicating the flow and direction of the current generated.

The open construction of all parts is a decided advantage in lecture work. The commutator and collecting rings are extra large. The brushes—two in number—can be placed in contact with either the commutator or the collecting rings. This construction and the employment of but two brushes avoids confusion, thus simplifying the tracing of circuits. The field magnet is dismountable by the removal of but two large knurled screws. The iron armature core is removable—a valuable feature in the study of the importance of core effect on motor action and dynamo output. Will operate as motor on 8 to 10 volt D.C. circuits.

Iron parts black gloss enameled, brass parts gold lacquered, mounted on mahogany finished 30x17.5 cm. hardwood base. Complete with field magnet as illustrated **$19.50**

387E. Gilley Gramme Machine. This machine represents an electrical motor-dynamo so designed that the lines of force may be readily plotted by the compass and filings method. This is made possible by the dissectible and flat-form construction employed. The dissectible feature allows each part to be examined and studied in detail. The flat-form construction permits, even during rotation, to trace the action of the magnetic fields by sprinkling iron filings on a paper or glass plate placed over the armature and field magnet jaws. Some of the things which can be taught with this laboratory device are:

(1) The lines of force in the field produced by an electromagnet. They may be mapped either by the compass or filings method.

(2) The effect of the soft iron ring of the armature upon the field produced by an electromagnet. The filings method shows this to good advantage.

(3) Armature and commutator construction, sectional windings and how terminals of each section are connected to commutator segments.

(4) Construction and function of brushes. By passing a current into armature, through the brushes, the reversal of the polarity of each section can be shown by the compass method.

(5) The reaction between the armature and electromagnet fields that produces rotation in motors. The filings method shows this nicely.

(6) How current is generated in the armature when it rotates in the field produced by the electromagnet. This may be shown by connecting our No. 574E Portable Galvanometer to the brush terminals, and revolving the armature by hand.

(7) The effect of armature speed on dynamo output.

(8) The effect of increasing and decreasing field strength on dynamo output.

(9) Series and shunt connected dynamos.

(10) The effect of increasing and decreasing field strength on motor speed.

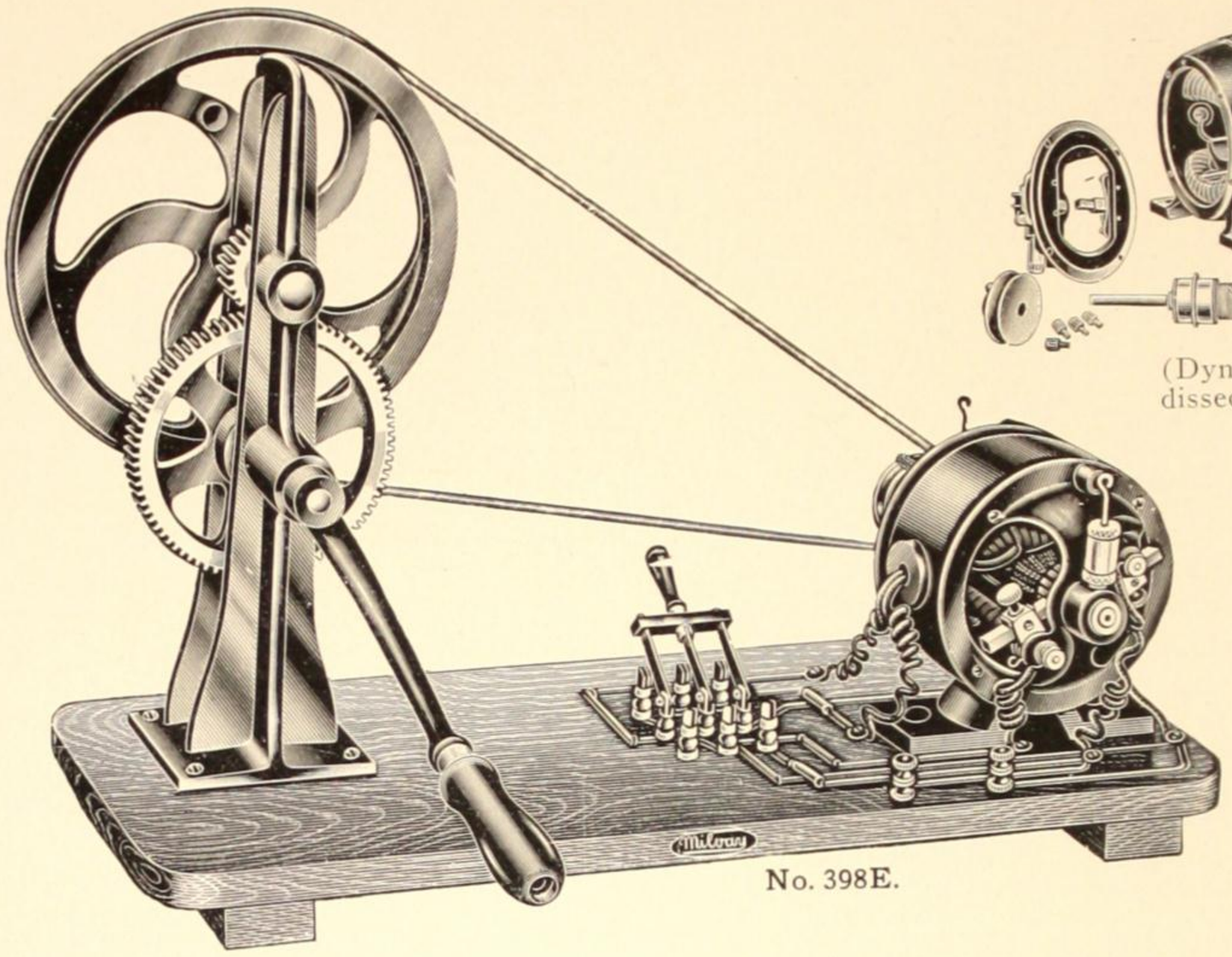
(11) Series and shunt connected motors.

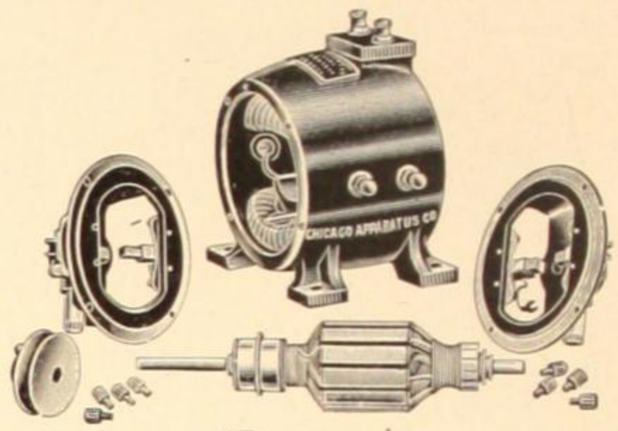
(12) Effect on a permanent bar magnet by the field of an electromagnet. The absence of rotation is explained by the fact that the poles do not reverse as they do in an electromagnetic armature provided with commutator.

(13) The effect of brush position on dynamo output and motor speed. This can be shown by rotating the brushes in a horizontal plane.

The current from two to three dry cells gives good results. Iron parts are finely finished in black gloss enamel. Other metal parts, except brushes, are nickel-plated. The brush mounting is adjustable vertically and horizontally. Complete as illustrated including bar magnet **$14.50**

Milvay Hand Power Dynamo





(Dynamo is dissectible.)

No. 398E.

398E. Dynamo, Hand Power, Milvay. In the dynamo and motor are found the most striking applications of electrical and magnetic science. Every student should, therefore, become familiar with their construction and principle of operation. This can be done easily and effectively with the Milvay Hand Power Dynamo, which is especially designed for laboratory demonstration work.

DISSECTIBILITY

Easily dissected by removing a few thumb screws, exposing the most important parts for minute inspection. All circuits, being clearly visible, are easily traceable.

SIX MACHINES IN ONE

The circuits in and the characteristics of the following important types of electrical machines can be demonstrated to fine advantage with the Milvay. The output varies with type, speed and load and cannot be correctly stated in a single watt reading. We therefore give detailed performance data below: "Load" has reference to lamps, motors, transformers or other current consuming devices connected to the output terminals.

1. Shunt Wound D.C. Dynamo. At 2000 R.P.M. with no load develops 35 volts. At the same speed with 11-ampere load develops 22.5 volts. At 1250 R.P.M. with 6-ampere load develops 11.5 volts.

2. Series D.C. Dynamo. At 2000 R.P.M. with 3-ampere load develops 18 volts.

3. Shunt Wound A.C. Dynamo. At 2000 R.P.M. with no load develops 25 volts. At the same speed with 11-ampere load develops 21 volts. At 1250 R.P.M. with 6-ampere load develops 11 volts.

4. Series A.C. Dynamo. At 2000 R.P.M. with no load develops 22 volts.

5. Motor. On a D.C. current of 10 to 12 volts operates as a powerful motor, developing about 1/10 H.P. at 2000 R.P.M.

6. Rotary Converter. By running the machine on a D.C. current of 10 to 12 volts an A.C. current may be drawn from the A.C. terminals, thus perfectly demonstrating the action of rotary converters.

CONSTRUCTION

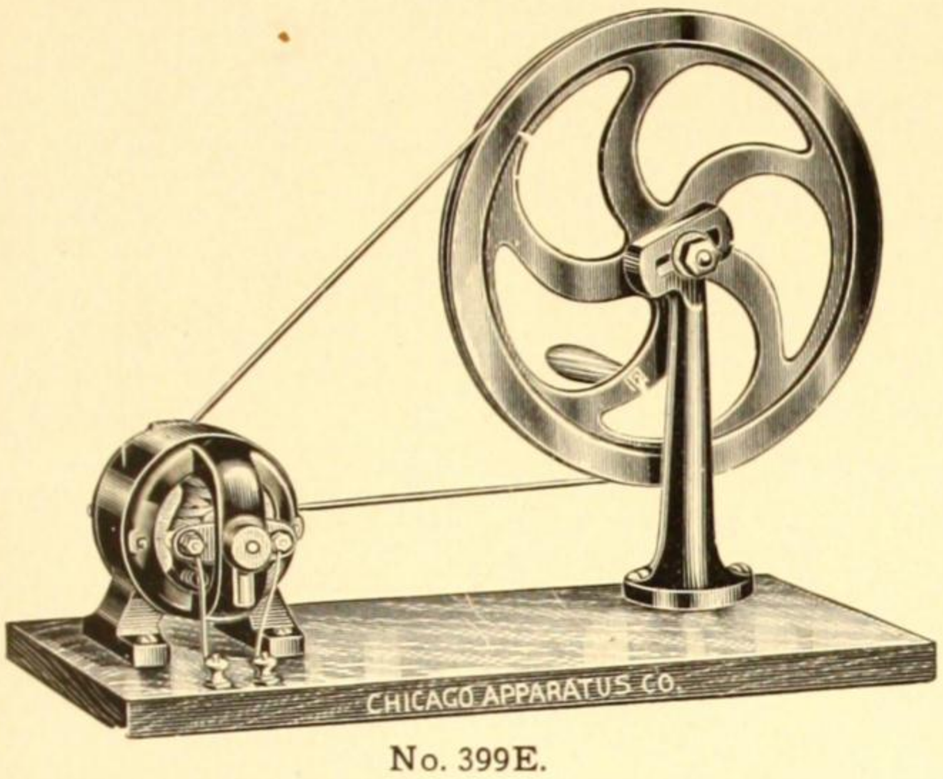
Armature. Standard drum type as used on modern commercial dynamos and motors. Extra large commutators.

Field Coils. Two in number, firmly locked in place, connections easily traceable.

Field Magnets. Solid ring type. Internally projecting pole pieces plainly visible when end plates are removed.

Driving Mechanism. Gear and belt drive, ratio 14 to 1. Proper armature speed—1250 to 2000 R.P.M. —are secured by 90 to 145 turns per minute. These speeds are far more easily attained with our combination mechanism than with the old style heavy, perforated belt construction.

Mounting. Dynamo and drive are mounted on a finely finished hardwood base with visible wiring and terminals for A.C. and D.C. A double throw switch permits instant change from Series to Shunt or vice versa. As all parts are finely finished the entire machine presents a most pleasing appearance. Complete, with full directions.....**$75.00**



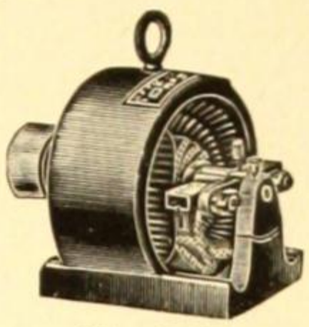
No. 399E.



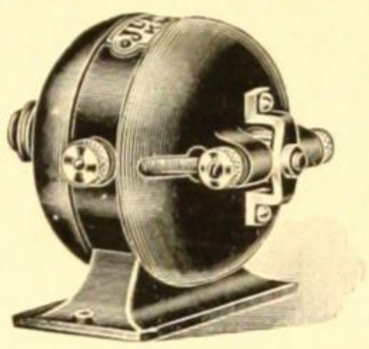
No. 400E.



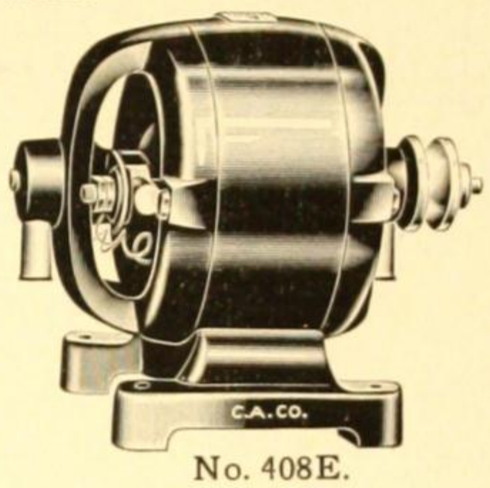
No. 402E.



No. 403E.



No. 405E.



No. 408E.

399E. Dynamo, Hand Power. An inexpensive model that yields highly satisfactory results in experimental and demonstration work. The dynamo closely resembles the large modern machines in general use. The drive mechanism is so proportioned that the maximum output—24 watts, 6 volts, 4 amperes—is easily obtained. This output is sufficient to operate induction coils, small motors, fans, electrolysis apparatus, electro-plating outfits, miniature lamps, etc. The armature is of the drum type, made of soft sheet iron laminations, six sections, carefully wound and shellacked. Field coils are form wound and well taped. Six section commutators of ample carrying capacity. Phosphor bronze brushes of the best quality. The head of the drive wheel support is slotted so that the tension of the belt can always be quickly adjusted to the best operating point. Two large binding posts on the base make it very convenient to connect accessory apparatus into the dynamo circuit. Complete as illustrated, on finely finished 20x45 cm. hardwood base..... **$25.00**

400E. Dynamo, Little Hustler. Same appearance as No. 743E Motor, but wound especially as a generator **$2.50**

402E. Dynamo and Motor. Consists of one No. 400E Little Hustler Dynamo and one No. 743E Little Hustler Motor mounted on a common base and connected as a Motor-Generator Set. so that the power developed by the motor is used to drive the generator, thus affording a nice illustration of the conversion of mechanical to electrical energy. The current output of the generator may be indicated on our No. 574E Portable Galvanometer..... **$6.00**

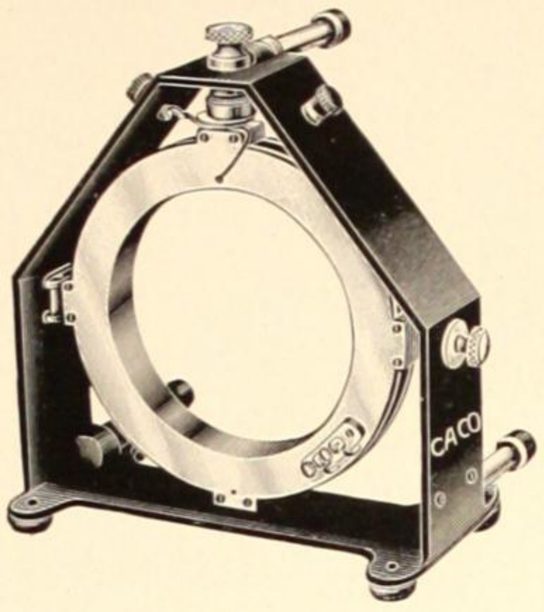
403E. Dynamo, K. & D. Shunt wound to obtain best results as a generator. It will light to full power 12 6-volt, 3-candlepower lamps. For electro-plating purposes it will operate a five-gallon solution successfully. Finished in black enamel. Fitted with 1½-inch grooved pulley. Length of shaft, 6 inches. Weight, 9 pounds. Occupies space 6x4¾x6 inches. At speed of 2200 R.P.M. the output is 36 watts (6 volts, 6 amperes) **$12.00**

405E. Dynamo, Plating and Charging Generator. For electro-plating and charging storage batteries. Fitted with 2¼-inch flat pulley. Overall height, 6½ inches; length of shaft, 9 inches; weight, 23 lbs. Generates 77 watts—7 volts, 11 amperes; speed, 2000 R.P.M. A high grade shunt wound machine designed for continuous duty..... **$33.00**

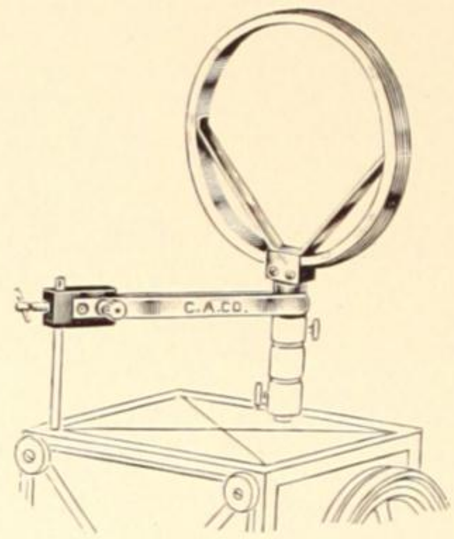
408E. Dynamo-Motor, D.C. As a Dynamo it generates 16 watts, 8 volts, 2 amperes, at a speed of 2600 R.P.M. Well adapted for lighting miniature lamps, operating induction coils, running small motors, decomposing water, charging small storage batteries, electroplating, and any other work requiring a D.C. current not exceeding 8 volts and 2 amperes. As a Motor it develops good speed and power on two cells of battery and will be found useful in operating mechanical models, etc. In construction it closely resembles the larger commercial machines in general use. Field and frame are cast in one piece. Armature is of the drum laminated type, six sections, carefully wound and shellacked. Field coils are form wound and well taped. Commutator is of the six-section type. Fitted with 1-inch, V-grooved pulley for $\frac{3}{16}$ to $\frac{5}{16}$ inch round belting. Finished in black enamel. Height 4½ inches, weight 4½ pounds **$9.75**

409E. Dynamo-Motor, D.C. Same as No. 408E, but for heavier duty. As a Dynamo it generates 32 watts, 8 volts, 4 amperes, at a speed of 2600 R.P.M. As a Motor it develops good speed and power on three cells of battery. This machine will do all that No. 408E does, but since it has double the output and double the power it will operate larger devices and give longer service. It has a 1-inch V-grooved pulley for $\frac{3}{16}$ to $\frac{5}{16}$ inch round belting. Height 5 inches, weight 5 pounds **$12.00**

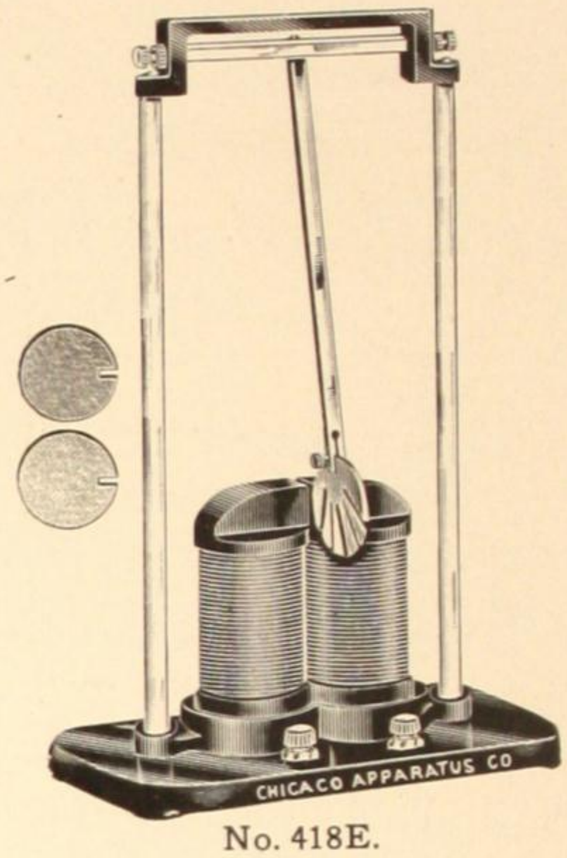
410E. Dynamo-Motor, D. C. Built along the same lines as Nos. 408E and 409E, but much larger. As a Dynamo it generates 100 watts, 10 volts, 10 amperes at 1800 R.P.M. As a Motor it develops 1/12 H.P. Very practical for lighting lamps having a total candle power of 150 or less, charging storage batteries and operating a great variety of other electrical devices and appliances requiring considerable current or power. It has 3-inch pulley for 1-inch flat belt. Height 6 inches, weight 16 pounds..... **$29.25**



No. 75M.



No. 413E.



No. 418E.

75M. Earth Inductor with Current Coil, Milvay. For measuring the horizontal (H) and vertical (V) components of the earth's magnetic field by the ballistic galvanometer method. A current coil or secondary winding, consisting of about 50 turns with independent binding post terminals, provides a new and simpler means for determining the current sensitivity or figure of merit (k) of the galvanometer employed.* After the throw resulting from rotation of the coil in the earth's field has been observed, the coil is kept in a fixed position and a current of known value is made to flow through the current coil. The interruption of this current will induce a current in the inductor coil, from the resulting throw of which the constant of the galvanometer can be readily determined. No wood is employed in the construction of this new instrument, consequently warping is impossible. It is made entirely of metal and finely finished. The improved springs, release, and stop employed assure sudden and accurate rotation through 180°. Since the effective area of the coil and the number of the turns in the coil must be known to calculate the final results, such data is given in a plate attached to each instrument.

Specifications

Effective area of the coil approximately..300 sq. cm.
No. of turns in inductor coil, approximately....1000
Resistance of inductor coil, approx.....410 ohms
No. of turns in current coil, approximately.....50
Resistance of current coil, approximately....1 ohm
Overall height of apparatus.....28 cm.

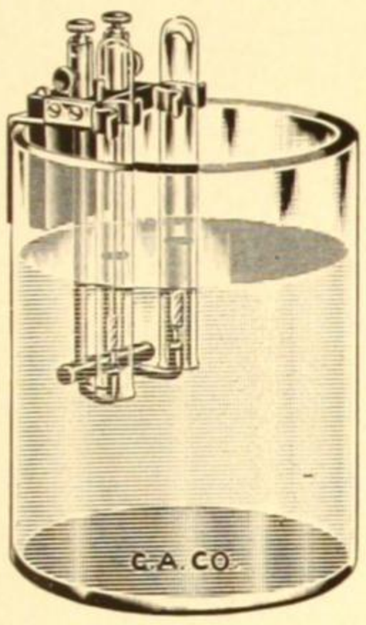
The apparatus is designed for use with equal ease in either horizontal or vertical position. Spring tension regulator with thumb screw control is provided. From a standpoint of construction, workmanship, appearance and performance, this new MILVAY instrument far excels previous models.....**$60.00**

*This improvement is in accordance with suggestions of Prof. A. L. Fitch, Physics Department, University of Maine, Orono, Maine.

413E. Earth Induction Apparatus, Milvay. A new design which yields far more satisfactory results. The frame is rigid. It does not wobble or vibrate at any speed. The coil—15 cm. in diameter—has a far larger number of turns (300) and generates a much heavier current. This eliminates the use of the highly sensitive suspension type galvanometers required with the former models and the current generated may be shown on a portable galvanometer, like our No. 574E. Our laboratory tests show that this new design will produce deflections of 5 to 30 divisions on our No. 574E Milvay Portable Galvanometer, the amount of deflection depending upon the position of the rotating coil with respect to the earth's magnetic axis. Provided with $\frac{5}{16}$-in. standard spindle, fitting any make of rotator. The illustration shows the apparatus in use on the new Milvay Gear Drive Rotator. Complete with commutator and conducting brushes **$15.00**

418E. Eddy Current Apparatus, New Milvay Design. For demonstrating the deadening or retarding effect of eddy currents on a conductor moving in a magnetic field. The pendulum with either the solid aluminum or solid copper disk in place will stop almost dead, in the magnetic field between the poles of the magnet, when the coils are connected in circuit with 2 or 3 dry cells. When no current is flowing through the coils there is no magnet field between the pole pieces and the pendulum will oscillate back and forth freely. With the slotted copper bob in place the deadening effect is materially lessened. Actual tests in our own laboratory show that when the current flowing through the coils is adjusted so that the pendulum with the solid copper disk in place comes to rest in 4 swings, it will come to rest in 20 swings with the slotted copper disk in place. With no current flowing the pendulum will come to rest in about 80 swings. Complete with one each solid copper and aluminum disk and one slotted copper disk. Made entirely of metal and mounted on a finely black enameled base. Height, about 35 cm. **$17.50**

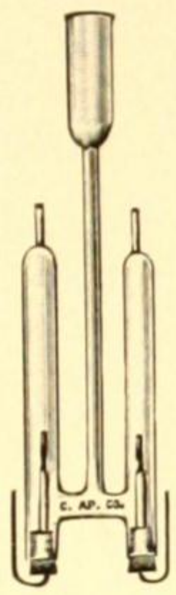
Electrolysis Apparatus



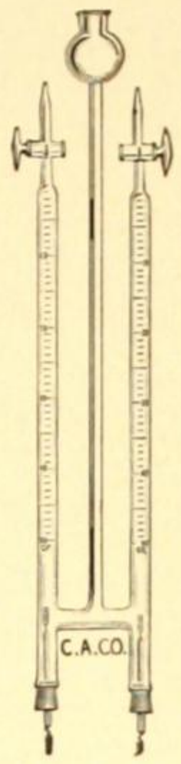
No. 422E.



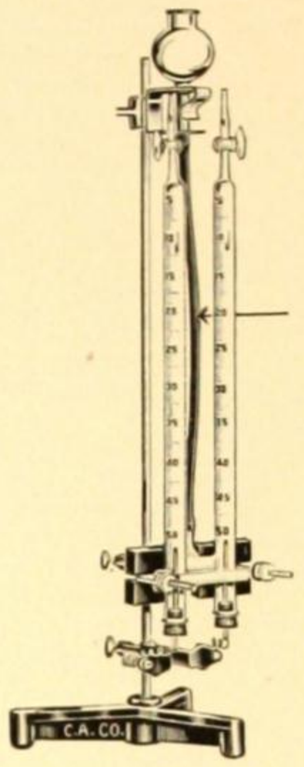
No. 424E.



No. 428E.



No. 433E.



No. 434E.

422E. Electrolysis Apparatus, Brownlee Form. Compactness, simplicity and convenience are characteristics of this popular student apparatus. Fits 4x5-inch or 5x7-inch battery jar. Either 5x5/8-inch, 6x5/8-inch or 6x3/4-inch test tubes may be used. The large binding posts, nickel-silver spring clips and platinum electrodes are mounted on a porcelain bracket. The latter is not affected by acids and other solutions. Including two plain test tubes, but without battery jar **$3.00**

423E. Electrolysis Apparatus, Brownlee Form. Same as No. 422E, but fitted with two test tubes graduated to 30 cc. in 10ths. Better suited for quantitative work than the above apparatus with plain tubes. Without battery jar **$4.25**

424E. Electrolysis Apparatus. For decomposition of water. With graduated tubes. Improved form with removable platinum electrodes. Superior to older models with sealed-in-electrodes. Overall height, 23 cm. Tubes graduated 10 cc. in 1/5's..... **$4.00**

425E. Extra Glass Part. For No. 424E, H-form part only, without graduated tubes or electrodes.... **$0.75**

426E. Extra Graduated Glass Tubes. For No. 424E. Each **$0.75**

428E. Electrolysis Apparatus. For decomposition of water. Improved form, with removable platinum electrodes (see No. 473E) that are easily replaced by electrodes of carbon or copper..... **$3.75**

429E. Electrolysis Apparatus. Same as No. 428E, but equipped with carbon instead of platinum electrodes **$3.25**

430E. Extra Glass Part. For No. 428E or 429E, without electrodes **$2.00**

452E. Support Stand. Correct design for properly supporting No. 428E..... **$4.00**

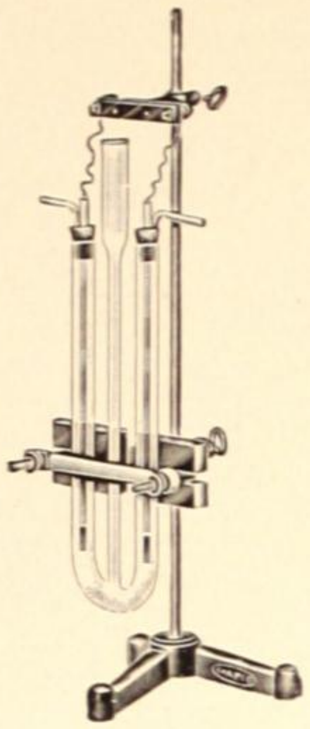
433E. Electrolysis Apparatus. Hoffman's. Improved form, with graduated tubes, glass stopcocks and removable platinum electrodes..... **$9.00**

433Ea. Extra Glass Part. For No. 433E, without electrodes **$7.25**

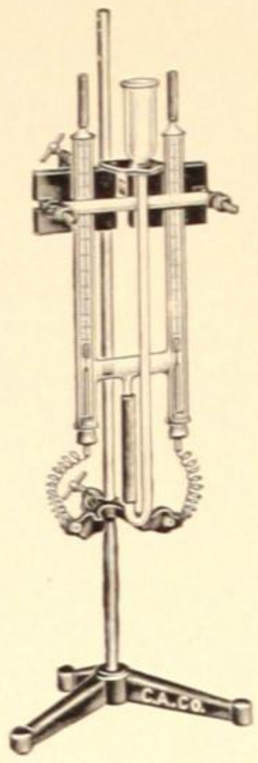
452E. Support Stand. Correct design for properly supporting No. 433E..... **$4.00**

434E. Electrolysis Apparatus, Hoffman—Milvay Precision Type. With the ordinary Hoffman's Apparatus it is impossible to show that the volumes of hydrogen or oxygen liberated are exactly as 2 to 1. This is due to the fact that the water in the graduated arms and reservoir being at different levels exerts unequal pressures on the gases. As a consequence the volumes of both gases are reduced, therefore, the volumes indicated by the apparatus are less than the true volumes. To overcome this source of error we offer an apparatus in which the reservoir is connected by a flexible rubber tube so that it can be adjusted as to height. By measuring the gas volumes after the water level in the reservoir has been made to successively coincide with the water levels in the hydrogen and oxygen arms, thus removing the pressure, readings are obtained that show a true 2 to 1 ratio. The apparatus has graduated arms, glass stopcocks, removable platinum electrodes and a support with special clamp for raising and lowering the reservoir **$16.00**

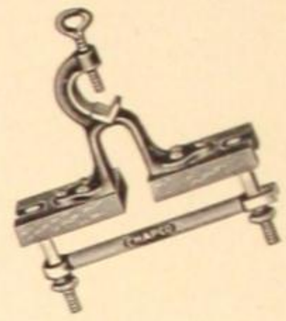
435E. Extra Glass Parts. For No. 434E, without electrodes or stand..... **$9.00**



No. 438E
with No. 452E.



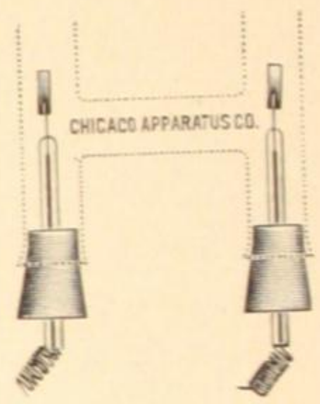
No. 441E
with No. 442E.



No. 443E.



No. 448E.



No. 473E.

Electrolysis Apparatus—Cont.

438E. Electrolysis Apparatus, Jewell. New form, designed by Prof. C. S. Jewell, Senn High School, Chicago, Ill., to overcome the disadvantages of the old form with electrodes inserted from below. Experience has shown that these electrodes will occasionally drop out, allowing the acidulous water to run out, and damaging not only the table-top and its contents, but also the operator's clothes. In this new form the electrodes are inserted in the top. They are mounted at the ends of long, thick-walled glass tubes through which the connecting wires pass. These tubes and the outlet tubes are fitted into suitable rubber stoppers. Complete with platinum electrodes, but without stand.....**$4.00**

452E. Support Stand. Correct design for properly supporting No. 438E.....**$4.00**

441E. Electrolysis Apparatus, Osborne Form. Useful in many ways—electrolysis of water—electroplating—ionization—conductivity of liquids—and other experiments. Design allows immediate change of liquids—introduction of indicators such as litmus, methyl orange, etc.—cloth for bleaching. It is easily cleaned. Consists of outer "U" tube with graduated sliding tubes, shot valves, glass plug, platinum electrodes (easily replaceable with carbon or copper electrodes listed below), and attachable water reservoir for electrolysis work. Height overall about 35 cm. Without stand **$8.00**

442E. Support Stand. Correct design for properly supporting No. 441E.....**$4.00**

Clamps for Electrolysis Apparatus

443E. Electrolysis Clamp. For clamping any form of electrolysis apparatus like our No. 424E, No. 428E, No. 433E or No. 438E to a support rod ¾ inch or less in diameter. The most satisfactory clamp of its kind on the market. Grips and holds the apparatus firmly without danger of breakage **$2.50**

448E. Electrolysis Connector Clamp. Consists of insulating bar with two double binding posts. Provided with clamp for attaching to support rod 19 mm. or less in diameter. Excellent for use in connecting sources of current with electrolysis apparatus. It takes the strain off the electrodes, thus protecting them against injury **$1.50**

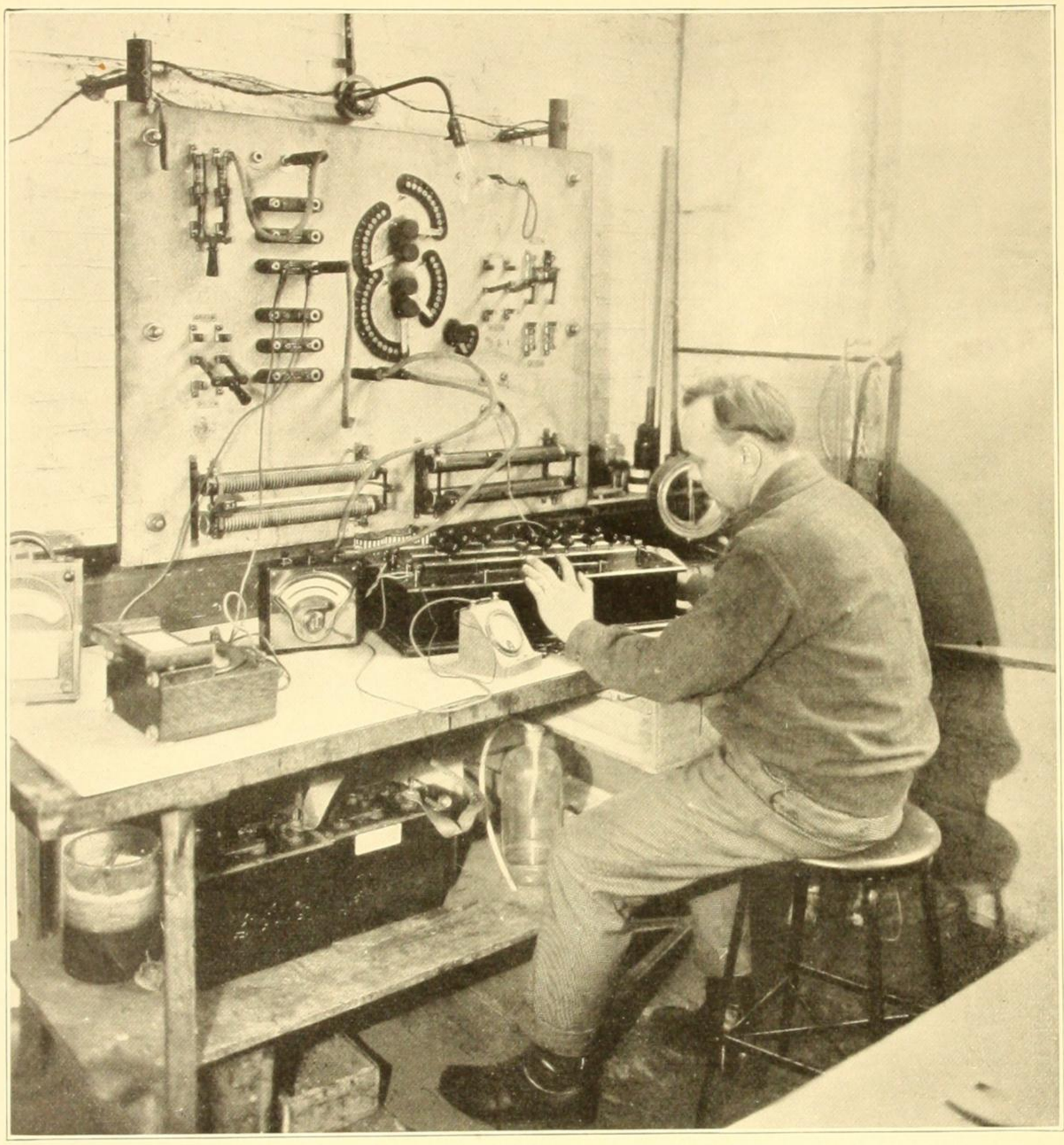
Electrodes for Electrolysis Apparatus

The following electrodes are made to fit either Nos. 424E, 428E, 433E, 434E or 441E Electrolysis Apparatus. The electrodes and connecting wires are sealed in short glass tubes and fitted into rubber stoppers as illustrated.

458E.	**Carbon Electrodes**	**Per pair**	**$0.50**
468E.	**Copper Electrodes**	**Per pair**	**.50**
473E.	**Platinum Electrodes**	**Per pair**	**1.75**

The following electrodes are made to fit No. 438E Jewell Electrolysis Apparatus. The electrodes and connecting wires are sealed in long glass tubes and fitted into rubber stoppers.

463E.	**Carbon Electrodes**	**Per pair**	**$1.50**
464E.	**Copper Electrodes**	**Per pair**	**1.50**
465E.	**Platinum Electrodes**	**Per pair**	**2.25**

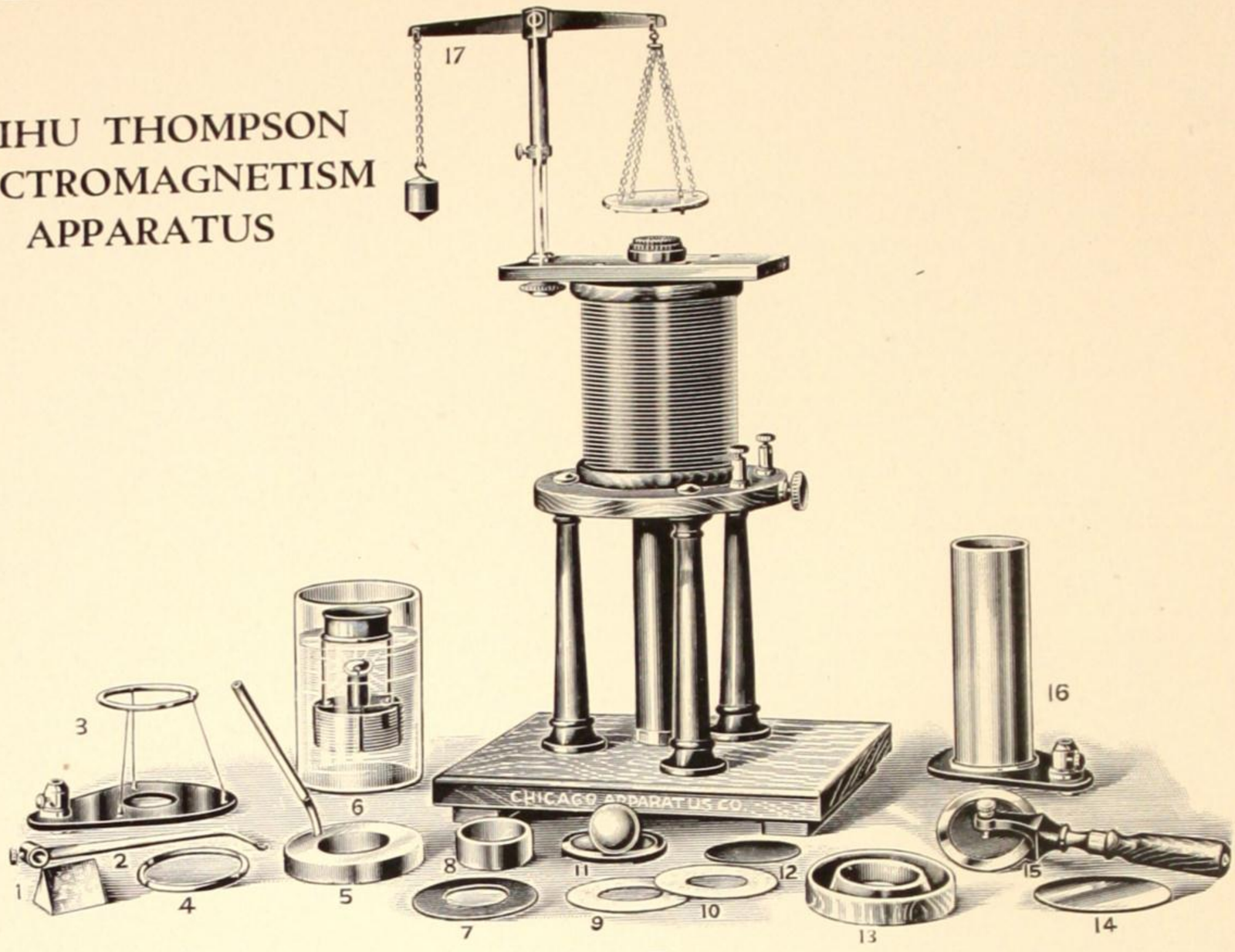


Electrical Testing

THE thousands of users who have had actual laboratory experience with *Milvay* Electrical Instruments have always found them well within their rated accuracy. Painstaking tests at every stage of manufacture and the use of highly accurate standards account for *Milvay* dependability.

The newly improved facilities installed in our plant simplify testing and assure even higher standards of accuracy, quality and dependability than heretofore.

ELIHU THOMPSON ELECTROMAGNETISM APPARATUS



No. 490E.

490E. Electromagnetism Apparatus, Elihu Thompson Type. For demonstrating in a striking manner some of the most interesting repulsion, attraction, induction and heating effects produced by the fields of D.C. and A.C. currents. The apparatus consists essentially of a large coil supported on three legs attached to a suitable base. The winding is designed for direct operation on 6-volt D.C. or 110-volt A.C. without the use of rheostats. The core is an assembly of soft iron wires, instead of a solid rod, to prevent the formation of parasitic Foucault currents in the core mass, which would seriously affect the efficiency of the coil when operated on alternating current circuits. The core is about twice as long as the coil and can be raised, lowered, and locked at any elevation required by the experiment to be presented. To the top of the coil is attached a platform with rod for supporting certain accessories. The apparatus is substantially constructed, beautifully finished, and furnished complete with the 17 accessories shown in the illustration.

Some of the experiments possible with this versatile instrument are described herewith:

1. Ring with Pendulum Suspension. (6-volt D.C.) The coil is placed on its side with the accessory support rod uppermost. Clamp (No. 2) is then attached in a vertical position to the extremity of the latter. From the end of clamp (No. 2) copper ring (No. 4) is suspended so that the extended core passes through it for a distance of several inches. The suspension must be adjusted so the ring can swing freely towards and away from the end of the coil. When the circuit is closed, the ring is thrust outwards and slowly swings back to its normal position. On opening the circuit, the ring is thrust towards the coil—in the opposite direction from before—and continues to oscillate back and forth about its normal position. When the circuit is closed and kept closed the oscillations are damped, while when the circuit is open and kept open the oscillations are undamped—a fine demonstration of Lenz's law governing electromagnetic damping.

2. Jumping Aluminum and Copper Rings. (110-volt A.C.) The core is raised up out of the coil six to eight inches. The copper ring (No. 4) is then slipped over the core. When the current is turned on, the ring is thrown violently upward into the air. The aluminum ring (No. 4A), because of its lighter weight, is thrown much higher. If the current is first turned on and the copper ring slipped over the core, it will remain suspended in mid-air at about the mid-point of the extended core.

3. Attracted Rings. (110-volt A.C.) If the copper ring is suspended in mid-air, as explained in the last part of the preceding paragraph, and the aluminum ring brought down over the core, it will attract the copper ring. If the aluminum ring is released both will cling together, maintaining their suspended position. The currents in the rings are in phase, causing attraction and this explains why they cling together. Both ring currents are, however, out of phase with the coil, causing repulsion and that is why both remain suspended.

4. Repulsion of Copper Ring. (110-volt A.C.) Frame with ring (No. 3) is clamped at the lowest point of the accessory support rod and the core raised six to eight inches so that it will extend well through the opening in the frame and ring. With the circuit closed the copper ring rises and remains suspended in mid-air at the ends of its restraining cords.

5. Steam Generation by Induction. (110-volt A.C.) The core is raised six to eight inches out of the coil. Bakelite ring (No. 7); asbestos ring (No. 9); steam generator, filled with water (No. 5); asbestos ring (No. 10); and ring weight (No. 8) are then slipped over the core in order. Within a short time after the current is turned on, steam will issue from the spout, due to the heating effect of the currents induced in the copper generator. Intense heating effects are also noticeable when the copper and aluminum rings are held for a while in the magnetic field surrounding the core.

6. Singing Membrane or Magnetic Growler. (110-volt A.C.) Core is lowered to its lowest point, as shown in illustration. Bracket and tube (No. 16), with circular iron membrane (No. 12) inserted in bracket recess directly underneath tube, is attached to the accessory support rod and adjusted to provide a clearance of 1 to 2 mm. between membrane and end of core. When the magnet is excited, a mechanical tone or "growl" corresponding to the frequency of the alternating current is emitted.

7. Submerged Glow Lamp. (110 Volt, A.C.). Jar containing waterproofed coil and lamp (No. 6) with enough water to completely submerge the lamp is placed over the end of the core, the latter being flushed with the top of the Thompson coil. When the circuit is closed, the lamp glows brightly indicating that neither the glass jar nor the water interferes with its action. If the jar with its contents be raised slowly and vertically the intensity of the lamp will gradually decrease and if raised high enough will cease to glow altogether. The magnetic field surrounding the end of the core decreases as the distance increases. Obviously the amount of current induced in the coil of the lamp decreases as it moves from the stronger to the weaker portions of the magnetic field. By placing copper disc (No. 14), iron disc (No. 12) and sheets of other materials under the jar, the damping effect of various substances can be shown.

8. Rotating Brass Ball. (110-volt A.C.) One-half the core is covered with copper disc (No. 14) and watch glass and ball (No. 11) placed over the end of the core. On closing the circuit the ball is set rolling. The ball may also be placed in a small beaker or crystallizing dish with just enough water added to cause it to float. The ball will now rotate rapidly about a horizontal axis.

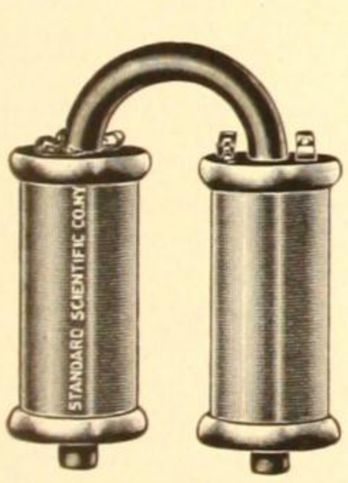
9. Rotating Copper Disc. (110-volt A. C.) With the core at its lowest point, iron prism (No. 1) is placed at the end of the core. With about half the prism covered by the copper disc (No. 14) the copper wheel in forked handle (No. 15) is brought near the uncovered portion of the prism. Attraction between the fields of the currents induced in the discs causes the mounted disc to revolve rapidly.

10. Repulsion of Copper Disc. (110-volt A. C.) Balance with counterpoise and copper disc (No. 17) is attached to the accessory support rod as shown in the illustration. Clearance between disc and end of core is adjusted to about 2 mm. When circuit is closed disc is repelled. By placing weights on the disc the force of repulsion can be measured.

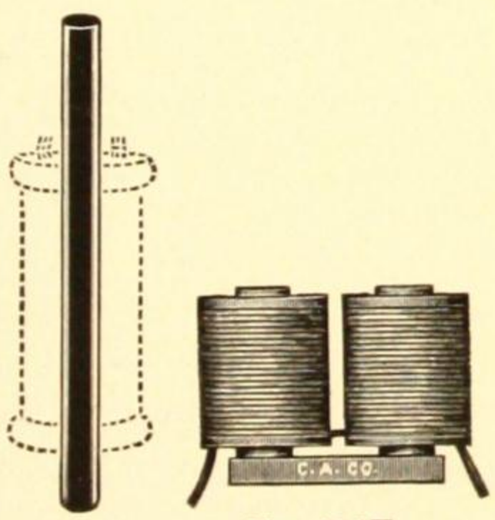
11. Mercury Trough. (110-volt A.C.) With the core lowered as far as it will go, trough (No. 13), containing mercury, is placed about it. On closing the circuit the mercury is set into wavy motion by inductive influence.

12. Induction Currents in Mercury. (110-volt A.C.) With the core lowered as far as it will go, dish (No. 11), filled with mercury, is placed over the end of the core. Copper disc (No. 14) is placed beneath the dish so that it covers about half of the core. When the circuit is closed two "rippling" streams shaped like the letter "D" move in opposite direction, revealing the interaction between the coil field and field about the current induced in the copper disc. The visibility of these streams can be enhanced by sprinkling cork or chalk dust on the mercury. The foregoing illustrates the principle of the induction motor.

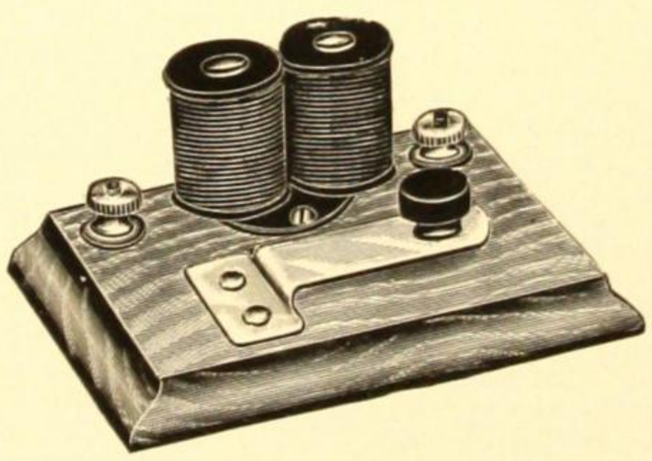
Furnished complete as illustrated, with 17 accessories and directions describing the foregoing experiments in greater detail, as well as many others. Height to top of coil, 45 cm.....**$65.00**



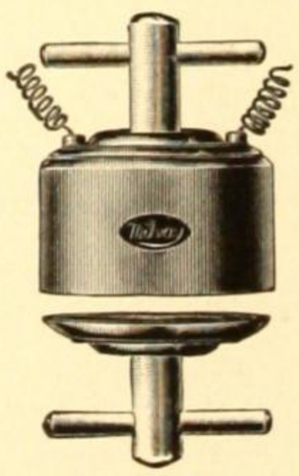
No. 493E.



No. 495E.



No. 496E.



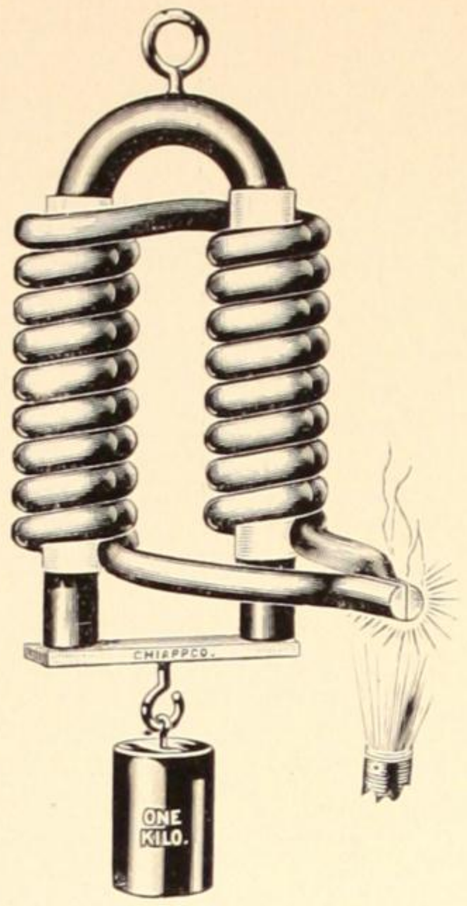
No. 498E.

493E. Electromagnet. Length, 10 cm.; helices, removable; soft iron armature with hook, three brass connectors **$2.25**

495E. Electromagnet. For experimental work and instrument making. Each coil measures 1½x⅞ inches. Resistance 5 ohms.....**$1.25**

496E. Electromagnet, Experimental. Many simple experiments are possible with this magnet, such as: Demonstration of electromagnet principles; plotting pole fields by the filings method; magnetizing needles, pieces of clock spring and small bar magnets; and giving light shocks. Also may be used as a simple lifting magnet and for demonstrating the principle of the telegraph sounder. On wood base with key for making and breaking the circuit. Resistance 5 ohms **$1.50**

498E. Electromagnets, Lifting, Milvay. A model of the commercial electromagnet used in machine shops and foundries. Diameter, 9 cm.; length over all, 16 cm. The coil, 300 turns of copper wire, is well insulated and removable. Will lift 300 pounds when excited with current from four ordinary dry cells. **$4.25**



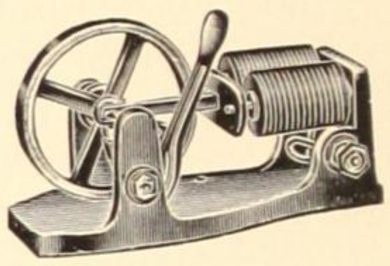
No. 500E.

500E. Thermoelectric Magnet, Milvay. For effectively demonstrating thermoelectricity by the power it develops in a lifting magnet. The form follows closely that of the conventional electromagnet and is, therefore, easy and convenient to use. It responds quickly and produces striking results.

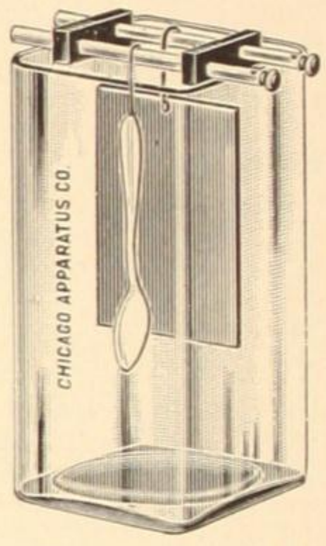
The thermocouple consists of two dissimilar metals of 10 mm. cross-section, brazed together to form a junction suitable for flame heating as illustrated. The other ends are riveted and fused to the terminals of two single-layer coils formed from heavy copper rod, also of 10 mm. cross section. Small spaces separate each turn. This construction, together with the insulation on the core, prevents all danger of short circuits between turns. The U-shaped core, of soft Norway iron, 16 mm. cross-section, is 15.5 cm. long and provided with suspension hook. The armature, also of soft iron, has a hook for the suspension of weights.

To operate, suspend the electromagnet from a suitable support and heat the junction in the flame of a Bunsen burner or, better still, of a Meker or other form of high-temperature burner. In about 30 seconds place the armature in position, which should then hold. In another 30 seconds attach a one-kilo hook weight to the armature hook. If the magnet does not now hold the weight allow the heating to proceed a little longer until it does. Other smaller hook weights may be added to determine the maximum weight-lifting power. The power of the magnet depends upon the intensity of the flame employed, and varies also to some extent in different magnets. Our tests on a large number of these thermoelectric magnets using our No. 495C Milvay burner for heating, showed the maximum lifting power to vary from 1.5 to 2 kilos, but to be conservative, we guarantee it to be at least 1 kilo.

Like an electromagnet, the strength of thermoelectric magnet depends upon the number of ampere turns, and this also depends upon the voltage, which in this case is the E.M.F. developed by the thermocouple upon heating. By the following method the ampere flow can be measured and the E.M.F. calculated. Remove the U-shaped core, which can be done quite readily, and wind upon it 18 turns of No. 16 B. & S. insulated copper wire, 9 turns on each leg, as in the case of the coils removed. Send a current from a battery through this substitute or test coil that will just lift 1 kilo and, with an ammeter, measure this current. In an actual test this was found to be 9.5 amperes. Consequently, this same amount of current must be flowing when the thermoelectric magnet lifts this same weight. Since the resistance of the heavy copper coils is known to be .00045 ohm (450 micro-ohms), it follows from Ohm's law, that the E.M.F. developed by the thermocouple was .00428 volt (4280 micro-volts). Similar determinations and calculations can be made for other lifting powers. Complete, as illustrated, but without weights or burner **$13.50**



No. 503E.



Nos. 508E-520E.

503E. Electromagnetic Engine. A simple mechanism showing a unique application of the electro-magnetic principle. A contact device makes and breaks the circuit during each revolution. This imparts a reciprocating motion to the armature which in turn rotates the crankshaft and its fly wheel. Provided with reversing lever. Runs well on one dry cell. Overall length, 12 cm. **$1.50**

508E. Electroplating Outfit, Copper. Square glass jar with two brass rods for supporting anode and objects to be plated. To insure proper spacing and to prevent loss the rods are mounted in fiber bars. On their ends are binding posts for making connection with the source of current. Complete with copper anode, chemicals, 4x4x8″ jar, and full directions **$1.75**

509E. Copper Anode Only for No. 508E..... **$0.25**

510E. Chemicals Only for No. 508E..... **.25**

513E. Electroplating Outfit, Nickel. Same as No. 508E, but with pure nickel anode, chemicals 4x4x8″ jar, and full directions **$2.85**

514E. Nickel Anode Only for No. 513E..... **1.00**

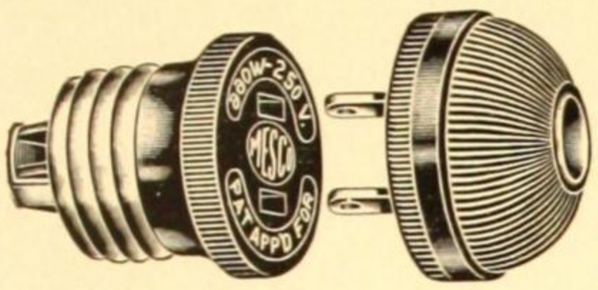
515E. Chemicals Only for No. 513E..... **.35**

505E. Electroplating Outfit, Silver. Same as No. 508E, but with pure silver anode, chemicals, 4x4x8″ jar, and full directions..... **$6.25**

506E. Silver Anode Only for No. 505E..... **3.50**

507E. Chemicals Only for No. 505E..... **1.50**

Fixtures—Electrical



No. 2215E.



No. 2226E.



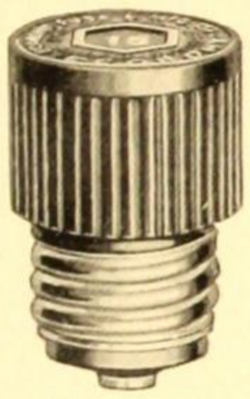
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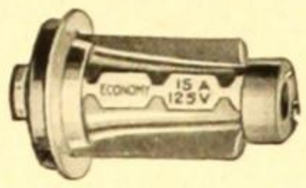
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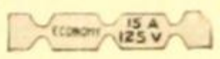
No. 2240E.



No. 2241E.



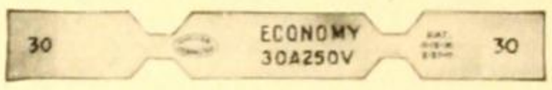
(Core only of No. 2241E with Link in place.)



No. 2242E.



No. 2244E.



No. 2245E.

2215E. Attachment Plug, Separable Type. Of black molded material, Edison Screw Base, removable plug cap with parallel brass blades **$0.15**

2220E. Plug Cap. As used on Nos. 2215E, 2225E and 2230E. Fits No. 2248E Receptacle. Of black molded material with parallel brass blades.... **$0.10**

2221E. Plug Cap. New Non-Breakable Type. Of molded semi-soft rubber, otherwise same as No. 2220E **$0.25**

2226E. Current Tap, Multiple. New three-way model of brown molded bakelite with Edison screw base, Edison screw socket for incandescent lamp or No. 2215E Attachment Plug, and two multiple side taps for No. 2220E Plug Caps. With this new tap three electrical devices, or two electrical devices and one incandescent lamp can be operated simultaneously from an ordinary light socket.

2230E. Current Tap, Series. New model of brown molded bakelite with Edison screw base, Edison screw socket for incandescent lamp or No. 2215E Attachment Plug, and series side tap for No. 2220E Plug Cap. Very convenient for operating bells, buzzers, small motors, electrolysis apparatus, electroplating outfits, and other devices requiring small amounts of either A.C. or D.C. current, direct on 110-volt lighting circuits, in series with an incandescent lamp. In all cases the flow of current through the apparatus is limited closely to the current draw of the lamp used..... **$0.75**

2235E. Fuse Plug-Cut-Out Block. Two-wire type. For Nos. 2240E or 2241E Fuse Plugs with Edison Screw base. For use on circuits up to 125 volts and for fuses up to 30 amperes. White glazed porcelain block, 3 1/16x2 1/2 inches **$0.40**

2240E. Fuse Plugs. With Edison screw base and clear mica window. The latter reveals at a glance whether the fuse link is blown or intact. For use on circuits up to 125 volts.

No.	A	B	C	D
Ampere capacity	6	10	15	30
Each	**$0.10**	**.10**	**.10**	**.10**

2241E. Fuse Plugs, Renewable Link Type. With Edison screw base. Blown fuse links can be quickly replaced in insert member. Will hold any No. 2242E Link.

No.	A	B	C	D
Ampere capacity	6	10	15	30
Each	**$0.60**	**.60**	**.60**	**.60**

2242E. Renewal Links, for 2241E.

Per 10	**$0.35**	**.35**	**.35**	**.35**

2243E. Cartridge Fuse Cut-Out Block. Two-wire type. For No. 2244E Cartridge Fuses. For use on circuits up to 250 volts and fuses up to 30 amperes. White glazed porcelain block, 3 7/8x3 inches.... **$0.75**

2244E. Cartridge Fuses, Renewable Link Type. For No. 2243E Cut-out Block. Blown fuse links can be quickly replaced. Will hold any No. 2245E link.

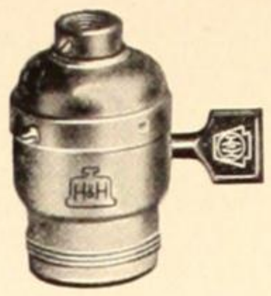
No.	A	B	C	D
Ampere capacity	6	10	15	30
Each	**$0.60**	**.60**	**.60**	**.60**

2245E. Renewal Links for No. 2244E.

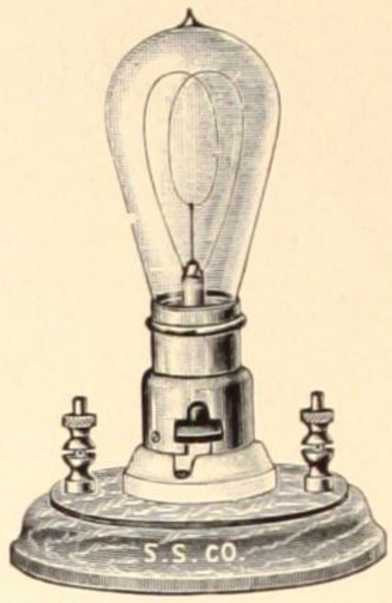
Per 10	**$0.45**	**.45**	**.45**	**.45**



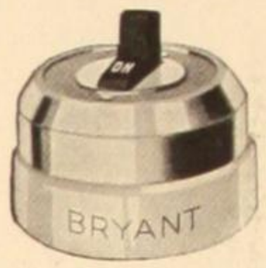
No. 2246E.



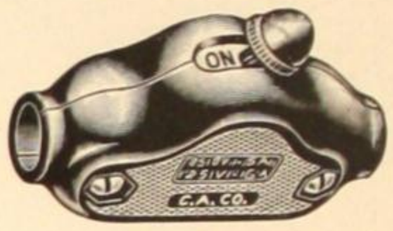
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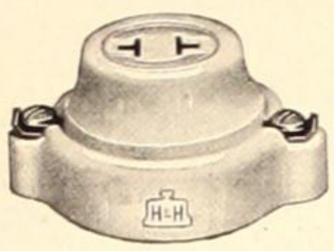
No. 2265E.
(With Lamp in Place.)



No. 2266E.



No. 2267E.



No. 2248E.



No. 2257E.



No. 2269E.

Fixtures—Electrical—Cont.

2246E. Receptacle, Keyless. Of white glazed porcelain, with Edison screw socket, two screw holes in base, and terminals for open wiring.....**$0.20**

2248E. Receptacle, Keyless. For No. 2220E Plug Cap or No. 2253E Socket. Of white glazed porcelain, with two screw holes in base and terminals for open wiring **$0.50**

683E. Receptacle, Keyless, Miniature. For No. 678E Lamps. Of white Glazed Porcelain with two screw holes in base and terminals for open wiring...**$0.20**

2250E. Receptacle with Key. Brass shell, porcelain base, with Edison screw socket, two screw holes in base and terminals for open wiring.....**$0.90**

2265E. Receptacle with Key, on Wooden Base. Any incandescent lamp with Edison Screw base will fit this receptacle. Useful in laboratory work on comparative lamp efficiency and the advantages of series and parallel connections. For the latter, four bases are usually used. On wooden base with two binding posts. Without lamp **$1.40**

2253E. Socket, Keyless. Of white glazed porcelain with Edison screw socket and two prong contacts for use with Nos. 2215E, 2226E, 2230E and 2248E **$0.40**

2255E. Socket with Key. For Edison screw base lamps and plugs. Brass shell type, for use on lamp cord or on pipe with ⅛ inch I.P. male thread. Easily taken apart, wired, and re-assembled.....**$0.45**

2257E. Adapter Pull Socket. For converting any key or keyless Edison screw-outlet to a pull chain type. Of brown molded bakelite with Edison screw base, Edison screw socket and 6½ inch pull chain switch **$0.45**

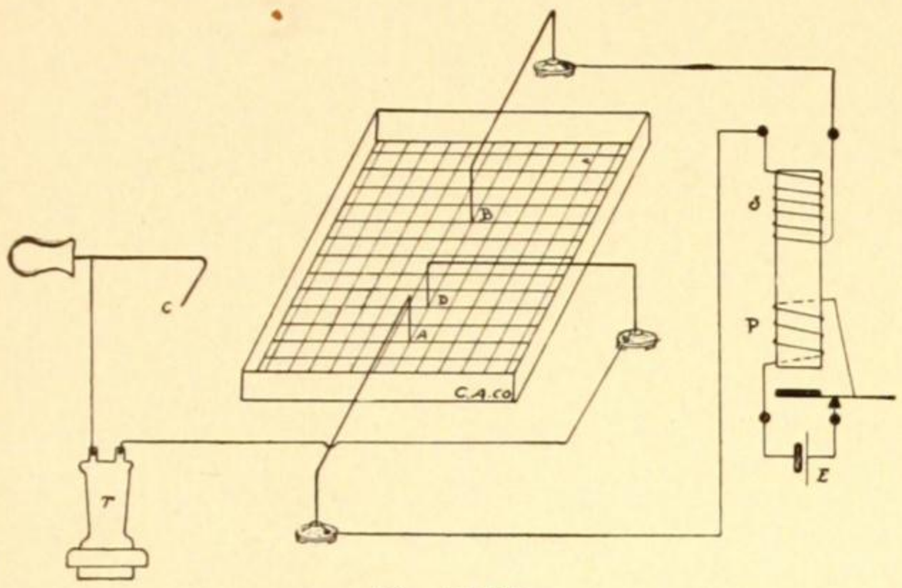
2266E. Switch, Tumbler, Indicating. Double pole, slotted porcelain base with two screw holes, nickel-plated metal cover, bakelite tumbler handle marked to indicate "on" and "off." For use on circuits up to 250 volts, capacity 10 amperes. Easier to install and more convenient to manipulate than the snap switch formerly listed **$1.50**

2267E. Switch, Tumbler, Cord Type. For attaching to lamp cords or extension cords so that the current can be switched on and off conveniently close to the apparatus. Especially convenient for operating apparatus from keyless or distant outlets. Of brown molded bakelite with tumbler handle marked "on" and "off." Very easy to install **$0.55**

2268E. Extension Cord. A six-foot length of double-conductor lamp cord with No. 2215E Attachment Plug at one end and No. 2255E Socket at the other. For extending the length of cords on apparatus to reach distant outlets, etc. **$1.00**

2269E. Extension Cord with Three Taps. A seven-foot length of double-conductor lamp cord with No. 2215E Attachment Plug at one end and a brown molded bakelite block with three two-finger current taps at the other. This block, being large and heavy, will lie flat on the table. It is also provided with screw holes for wall mounting. Its use permits the operation of three devices from a single outlet or socket **$1.75**

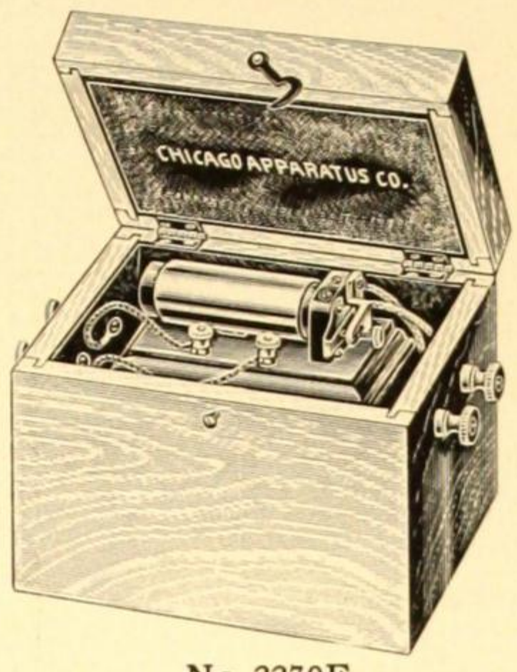
2271E. Lamp cord with Universal Tips. A six-foot length of double-conductor lamp cord with No. 2215E Attachment Plug at one end and two No. 282E Universal Terminals at the other. For connecting devices with binding post terminals into lighting circuits **$1.00**



No. 517E.

517E. Field Tray. For mapping the lines of constant potential and the lines of flow in a layer of conducting liquid by the method described in the manuals of Ames and Bliss or Millikan and Mills. Consists of a leak-proof tray with a glass bottom to the underside of which a sheet of co-ordinate paper, having 25x25 mm. squares, is so attached that the rulings are plainly visible from above.

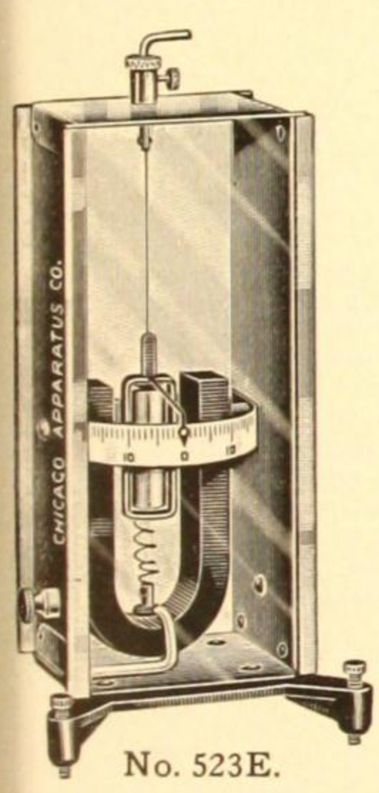
Four points, three mounted on bases and one in a handle, together with the necessary connecting cords, are included. Two of the points with base serve as electrodes for conducting the current from the secondary of an induction coil into and out of the solution. The third point with base serves as the fixed telephone terminal, and the fourth point, which is mounted in a handle, as the movable or free telephone terminal. The tray measures approximately 37.5 x27.5 cm., inside. The price does not include telephone receiver or induction coil **$13.50**



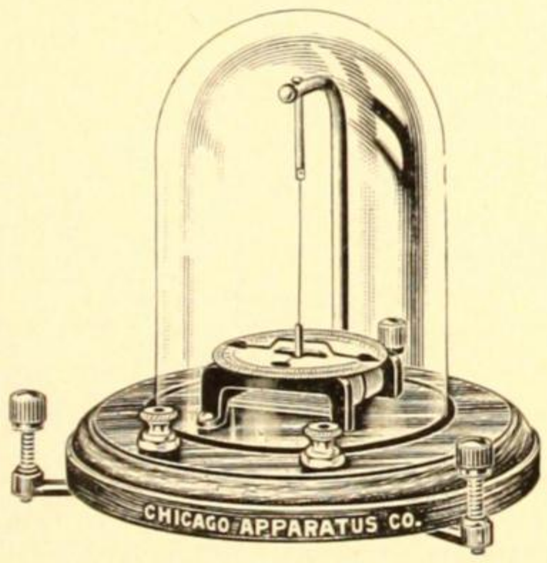
No. 2270E.

2270E. Induction Coil, Sound-Proofed. Operates on a current of 1.5 to 2 volts and produces an alternating current having a frequency of about 500 v.p.s., which is suitable for use in mapping the lines of constant potential and the lines of flow in a layer of conducting liquid by the field tray method. Mounted in a finely finished sound-proof case, 12x 12x15 cm., with hinged cover. Both primary and secondary terminals are on the outside of the case as illustrated **$8.50**

Galvanometers



No. 523E.



No. 518E.

518E. Galvanometer, Astatic. Improved form. The moving system consists of two small magnetic needles, fixed to a vertical bar to which the aluminum pointer is also attached. The coil is arranged so that one branch is between the magnetic needles, the other below both. The suspension is an unspun silk fiber. Mounted on 16 cm. base with leveling screws and 10x5 cm. glass shade. A delicate galvanometer for the measurement of very small currents **$8.00**

523E. Galvanometer, D'Arsonval, New Milvay Design of the Millikan, Gale and Bishop Type. Offers these many advantages over other designs:

1. Far Stronger Case. Made of much heavier steel and so formed as to impart maximum strength and rigidity to the instrument.

2. New Coil Arrester. A metal pin attached to the underside of the upper horizontal portion of the coil projects down into a sizable hole in the top center of the core. This limits the sidewise and "to and fro" motion of the coil to within fairly narrow limits, preventing breakage of the suspension and bending of the pointed. It does not in any way interfere with the normal functioning of the instrument. On the contrary, it is a distinct help in adjusting the coil and leveling the galvanometer.

3. Glass Front and Back. This makes all parts inside of the case plainly visible. No inside shadows or shaded portions as in the closed-back types. As a result it is easier to adjust the coil to level the instrument, to read the scale, and to get at the inside when necessary.

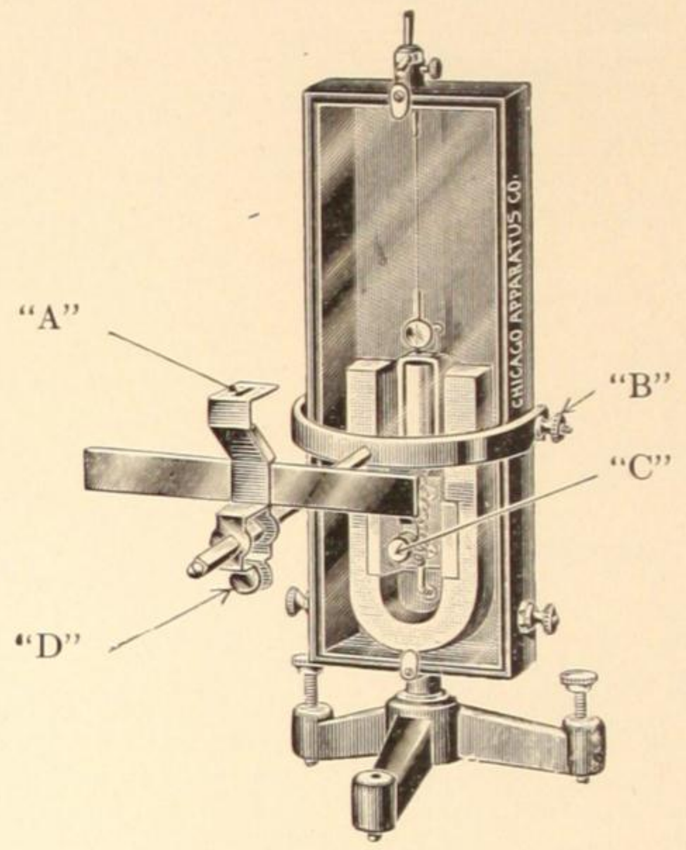
4. Standard Coil Wound on Copper Frame. The coil is of the same high grade construction as that used in the more expensive instruments. It consists of many turns of insulated copper wire of fine gauge, wound on a copper frame closed to provide proper damping. The resistance is 100 ohms.

5. Stronger Suspensions. Made of special phosphor bronze ribbon of ample tensile strength, reducing breakage to a minimum.

6. High Sensitivity. A current of 1 volt through 240,000 ohms deflects the pointer one scale division. This is equivalent to a deflection of one millimeter on a scale one meter distant, for a current of 1 volt through a resistance of 9.6 megohms.

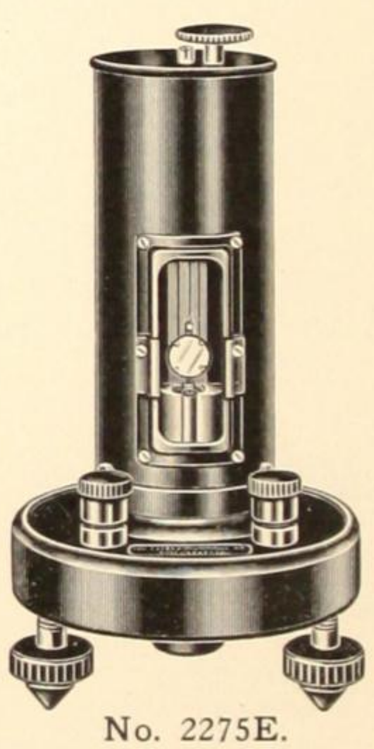
7. Larger Size. Height, 24 cm.; depth, 10 cm.; width, 10 cm. No other low-priced make offers the large size, the great strength and the many other exclusive and advantageous features enumerated above **$6.75**

529E. Galvanometer, D'Arsonval, Milvay with Three-Way Scale Adjustment. No other D'Arsonval Galvanometer offers the many advantages that this new model does. The three-way scale adjustment and the observation slit in horizontal plane (A) makes work with this galvanometer a real pleasure. A few turns of the side adjustment (B) brings the scale image exactly to zero. A turn or two of the up and down adjustment (C) centers the scale image properly in the coil mirror. By means of the in and out adjustment (D) the scale is instantly adjusted to the point best suited to the observer's range of vision—where the image appears sharpest. The **Observation Slit** (A) in the horizontal plane above the inclined mirror is much more convenient and more comfortable than the slit in vertical plane furnished on older models. The **Scale** is straight—the correct type for magnets with flat poles, as this gives practically proportional scale deflections. The **Suspensions** are much heavier than those ordinarily employed in instruments of this kind and they will therefore give much longer service. The average **Sensibility,** based on a large number of careful tests in our own laboratory, shows 6.45 megohms at working distance, which is equal to 38.7 megohms at one meter $10.00

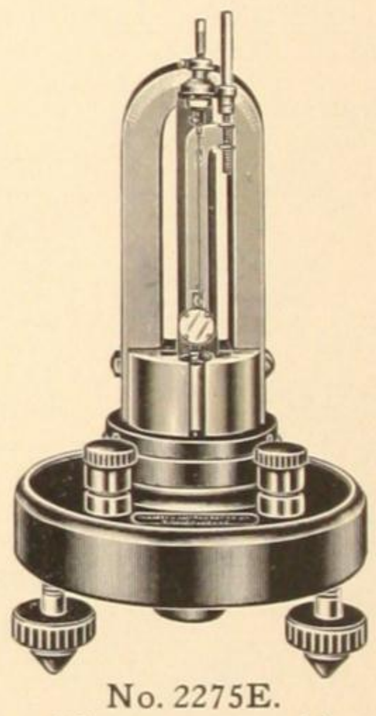


No. 529E.

2275E. Galvanometers, Reflecting, Type R., L. & N. These high-class mirror-coil galvanometers are far more sensitive than those listed under Nos. 2280E-A-B-C. They are suitable for research and precision work of a high order. The magnets are steel with pole faces shaped to produce a radial field to insure proportional deflections through a wide range. To provide the magnetic fields of intensity necessary to gain high sensitivity the air gaps between coil and core and between coil and pole face are very small—about $\frac{1}{16}$ inch. The bases are molded bakelite supported by petticoat-insulated leveling screws and have dust-tight cases finished in dull black. Zero adjustment is by means of a large knurled head at the top of the case. For convenience in replacing, suspensions are of the removable type. All have 13 mm. plane mirrors. Lens holders and 1-meter focus lenses are provided so that either a telescope and scale or a beam of light reading device may be used. Binding posts and suspensions are of copper to lessen internal thermal effect. Five characteristics are available. Prices do not include reading devices. They are listed separately on page 68.

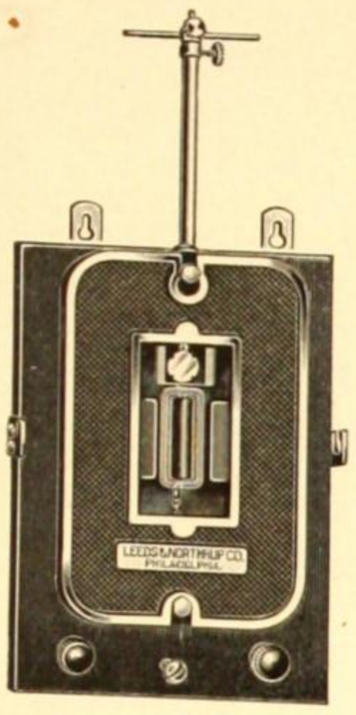


No. 2275E.

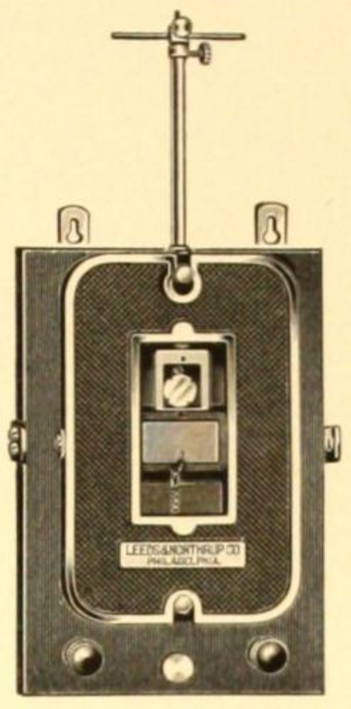


No. 2275E.
(Cover removed.)

No.	A	B	C	D	E
Sensitivity, per mm. at 1 meter					
Microamperes	——	0.0005	0.005	0.003	0.0001
Megohms	——	2000	200	333	1000
Microvolts	0.5	——	——	——	——
Period, seconds	6	6	5	3	14
Coil resistance, ohms	10	500	40	500	500
External critical damping resistance, ohms	50	10,000	300	2,000	22,000
Each	**$60.00**	**60.00**	**60.00**	**60.00**	**60.00**



No. 2280E.



No. 2285E.

2280E. Galvanometer, Reflecting Type P., L. & N. This type of mirror galvanometers long have been the standard in student laboratories. The combination of strength, accessibility, and visibility with good sensitivity adapts them to a wide variety of uses in physical, physical chemistry, and electrical laboratories. Furthermore, their construction reduces the need for repair or adjustment to a minimum—and makes them easy when necessary. A recent refinement consists of a lens holder in which a 1-meter focus lens, supplied with each instrument, is held directly in front of the 16-mm. plane mirror with which these galvanometers are equipped. Thus, while suited for use with the usual telescope and scale reading device, they may also be used with a lamp and scale. In earlier models the beam of light method could not be used with plane galvanometer mirrors, and this made it necessary either to change mirrors or to provide an additional galvanometer having a concave mirror. The new construction obviates this cumbersome procedure and extra expense, and increases the usefulness and convenience of these popular galvanometers. Three sets of characteristics are available. No. 2280E-A, because of its moderate current sensitivity, is best suited for use as a balance indicator in bridge and potentiometer circuits, and for routine deflection work. No. 2280E-B is a high-resistance, high-current-sensitivity type which is well suited for use in the measurement of insulation resistance, leakage currents, etc. As a balance indicator in bridge circuits with high resistance arms it permits far closer adjustment than less sensitive types. No. 2280E-C has maximum voltage sensitivity, and is therefore suitable for measuring thermocouples. Each instrument is mounted on a finely finished wood back provided with eyelets for wall mounting and fittings for attaching the arm carrying the telescope and scale. Prices are for galvanometer only as illustrated. Reading devices are listed on page 68.

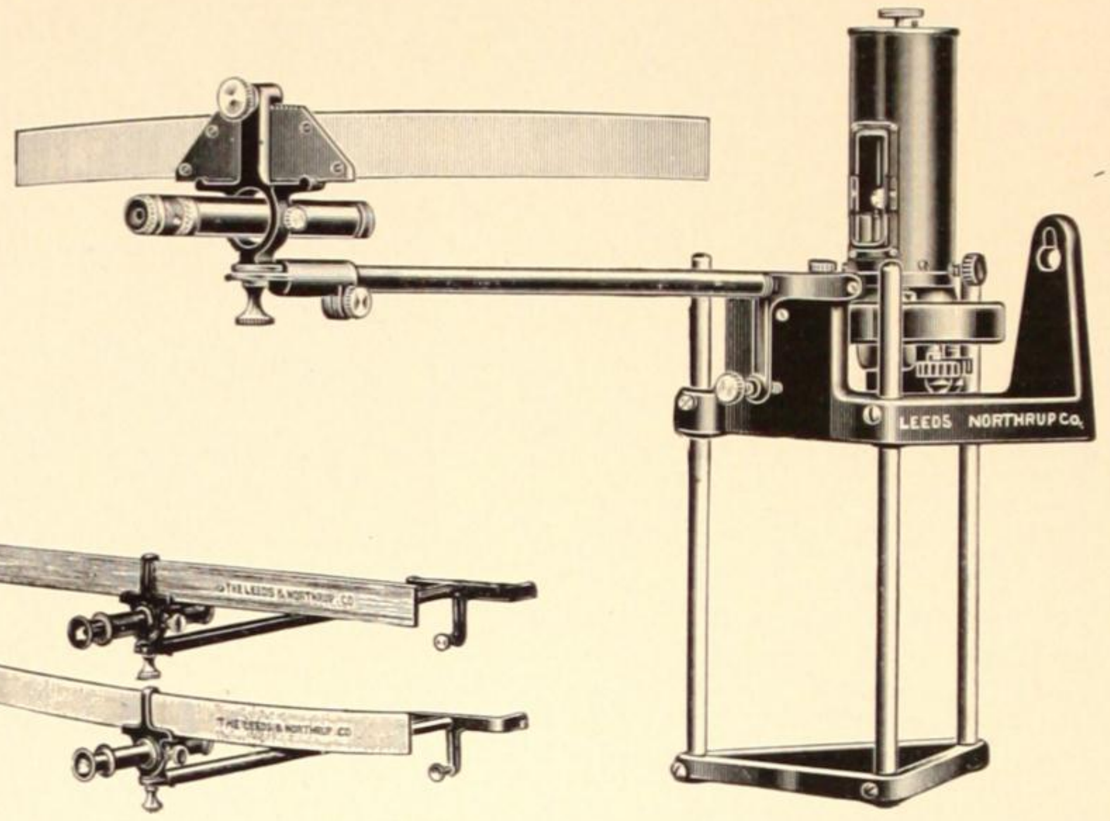
No.	A	B	C
Sensitivity, per mm. at 1 meter			
Microamperes	.014	.001	——
Microvolts	——	——	1.5
Megohms	71.5	1000	——
Period, seconds	8	14	14
Coil resistance, ohms	115	1000	35
External critical damping, ohms	10,000 to 100,000	10,000 to 25,000	165
Each	**$25.00**	**25.00**	**25.00**

NOTE: Sensitivity is at least as high as stated; other characteristics may vary, but not more than 20%. Microvolt sensitivity is for critical damping in series. Coil resistances include resistance of suspensions.

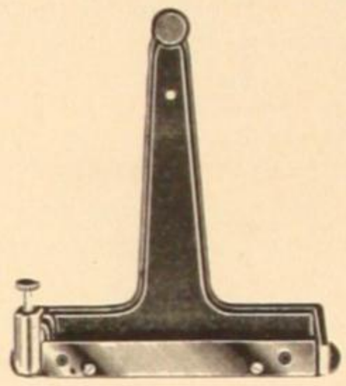
2285E. Galvanometer, Ballistic, Type P., L. & N. The galvanometers listed above (2280E-A-B-C) require a steady current to cause their deflections to be proportional to the current flowing through them. This galvanometer, while similar in appearance to them, has a mirror coil so constructed that when a quantity of electricity is discharged through it, provided the entire charge has gone through before the coil has started sensibly to move, the magnitude of the first deflection is proportional to the quantity of electricity so discharged. This BALLISTIC characteristic makes this galvanometer suitable for measuring the capacity of condensers and telegraph cables; comparing capacities of condensers by the zero or bridge method; determining the magnetic induction in test coils employed in magnetization and hysteresis work; absolute measurements of H and V by means of an earth inductor; and in the experimental analysis of dynamo induction.

Sensitivity per mm. at one meter is 0.002 microcoulombs; period, 26 seconds; critical damping, external, 10,000 ohms; coil resistance, 2,000 ohms. The coil carries a 16 mm. plane mirror. A lens holder and a 1-meter lens also is provided so that this galvanometer may be used with either a telescope and scale or a beam of light reading device. On finely finished wood back with eyelets for wall mounting and fittings for telescope arm. Price does not include reading devices. They are listed separately on page 68 ..... **$35.00**

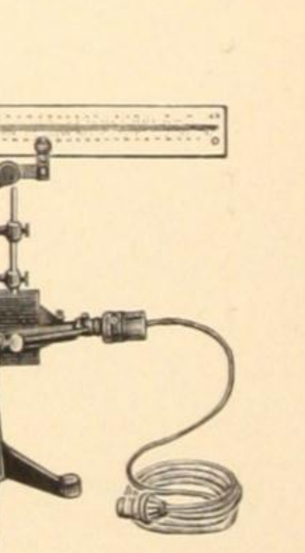
Galvanometer Reading Devices



No. 2330E. (with Galvanometer in Place).



No. 2320E.



No. 2325E.

No. 2290E.
No. 2295E.

2290E. Telescope and Straight Scale, with Arm, L. & N. This reading device is recommended for use with Nos. 2280E-A-B-C galvanometers. These instruments do not have radial fields, and the tangent error with a straight scale tends to offset the cosine error arising from a linear field. Scale distance 50 cm., 500 mm. divisions, marked 25-0-25 (cm.) . **$16.00**

2295E. Telescope and Curved Scale, with Arm, L. & N. Recommended for use with No. 2285E. Ballistic Galvanometer, as it will give readings that are practically proportional to the electric quantities discharged through it. Scale distance 50 cm., 500 mm. divisions, marked 25-0-25 (cm.) **$20.00**

2300E. Mounted Straight Scale only of No. 2295E **4.00**

2305E. Mounted Curved Scale only of No. 2295E **8.00**

2310E. Arm only of Nos. 2290E and 2295E. **5.00**

2350E. Telescope only of Nos. 2290E and 2295E. **7.00**

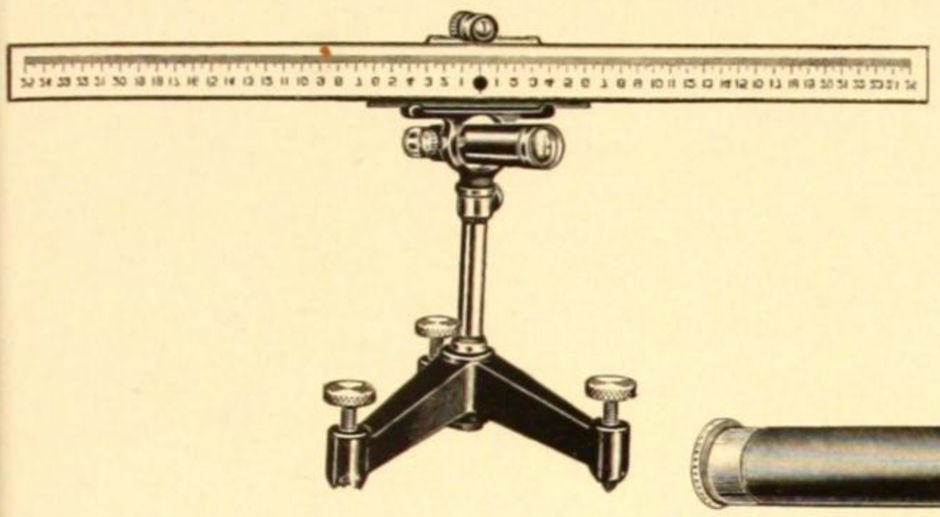
2320E. Wall Mounting for Nos. 2280E-A-B-C and 2285E Galvanometers. A metal plate with leveling screws providing in and out as well as sidewise adjustment, so that the moving system of a wall galvanometer may be centered as easily as the table types **$7.00**

2325E. Table Mounting for Nos. 2280E-A-B-C and 2285E Galvanometers. The three leveling screws provide full adjustment for centering the moving system **$7.00**

2330E. Telescope and Curved Scale, with Support, L. & N. Convenient for use with Nos. 2275E-A-B-C-D Galvanometers. The scale is curved to avoid tangent errors, when used with galvanometers having a radial field such as those mentioned above. The mounting is designed to hang from the wall or to stand on a table. When used on a wall the legs and triangular base may be removed. Telescope and scale is included. Scale distance 50 cm., 500 mm. divisions, marked 25-0-25 (cm.) **$30.00**

2335E. Lamp and Scale, L. & N. For reading the deflections on mirror galvanometers (Nos. 2280E-A-B-C and Nos. 2275E-A-C) by the beam of light method, which is especially valuable in lecture work. Also it is a convenience in work involving a large number of consecutive deflections. The scale markings are deeply etched in plate glass and cleaning will not obliterate them. Without changing the lens this lamp and scale can be used as far as two meters from the galvanometer. Two heavy plate glass, etched scales are included, each with 500 mm. divisions, one marked 0-50 (cm.), and the other 25-0-25 (cm.). The lamp, 21 candle-power, operated on 6 to 8 volts. A small transformer like our No. 1033E is excellent for supplying this low voltage from a 110-volt A.C. line. Complete, with stand, lamp, lamp housing with lens system, scales, and cord with plug **$30.00**

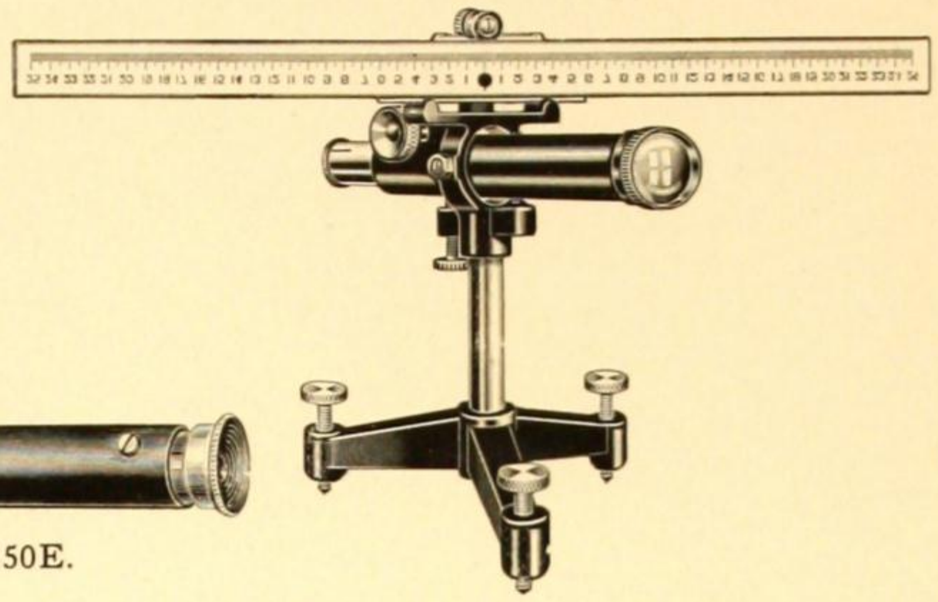
No. 2335E.



No. 2340E.



No. 2350E.



No. 2345E.

Separate Telescopes and Scales

To gain apparent sensitivity or ease of reading, these reading devices may be used at varying distances from the galvanometer—one, two, or three meters. Two grades are available—one for students' use, the other for precise investigational work. Both have straight scales and altitude and azimuth adjustments.

2340E. Telescope and Scale, Students', L. & N. Magnifying power of telescope—6 diameters. Scale is mounted on straight metal strip, has 500 mm. divisions, and is marked 25-0-25 (cm.). Complete on adjustable tripod stand with leveling screws. . **$27.00**

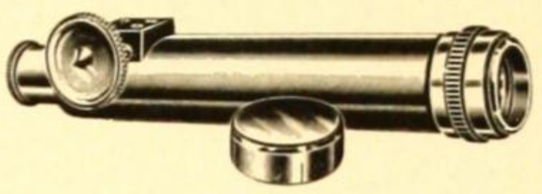
2345E. Telescope and Scale, Precision Type, L. & N. Telescope is provided with rack and pinion for greater convenience in focusing and has a magnifying power of 12 diameters. The scale is mounted on a straight metal strip, has 500 mm. divisions, and is marked 25-0-25 (cm.). Mounted on a substantial and adjustable tripod support with leveling screws **$55.00**

2350E. Telescope only of No. 2340E. Magnification, 6X **$7.00**

2355E. Telescope only of No. 2345E. Magnification, 12X **$25.00**

2360E. Galvanometers, Portable, Pointer Type, L. & N. With horizontal scale. The design combines extreme simplicity and ruggedness with sensitivities sufficient for bridge work to an accuracy of .1% and for potentiometer measurements to .05 millivolt. The moving systems are robust and will withstand severe shocks without damage. They are built into molded bakelite units, equipped with a large convenient zero adjusting knob at the top and mounted in substantial, molded bakelite cases. The etched metal scale has 15-mm. divisions each side of center zero. Warping, such as occurs in paper scales, is impossible. The pointer is of the knife edge type. Dimensions, 7x10x11.5 cm. Weight, 2 lbs. Three sets of characteristics are available.

No.	A	B	C
Sensitivity, per mm. division, microamperes...	5	1	0.5
Period, seconds	3	3	3
External critical damping resistance, ohms	50	950	2,400
Coil resistance, ohms	20	250	1,000
Each	**$15.00**	**15.00**	**15.00**



No. 2355E.

2365E. Galvanometers, Portable, Pointer Type, L. & N. With vertical scale. These galvanometers are similar to No. 2360E, but the scales are vertical instead of horizontal. Furthermore, to provide maximum visibility of the indication in lecture or routine work, a pointer of the target type has been provided.

To further increase the ease of reading, the number of scale divisions has been reduced to 10 each side of the center zero. Because of these arrangements of the scale, this type of galvanometer is adapted to lecture demonstrations and work involving numerous successive measurements by the balance or zero method. The moving system is of the same robust design as in No. 2360E and likewise is mounted in a molded bakelite case. Zero adjustment is provided by means of a slotted screw on top of the unit. Dimensions, 7x10x11.5 cm. Weight, 2 lbs.

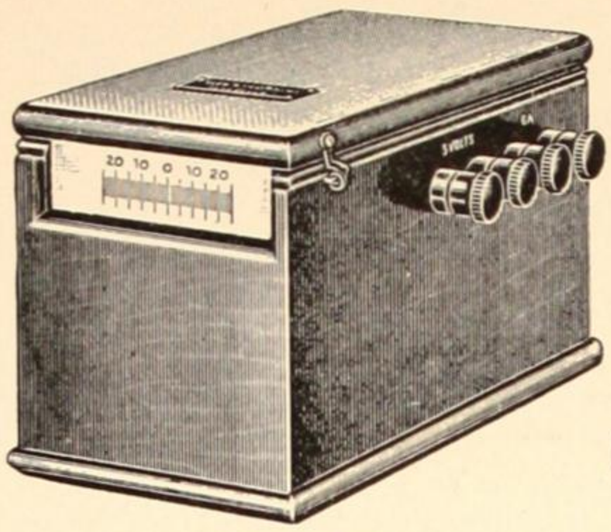
No.	A	B	C
Sensitivity, per mm. division, microamperes...	5	1	0.5
Period, seconds	3	3	3
External critical damping resistance, ohms	50	950	2,400
Coil resistance, ohms	20	250	1,000
Each	**$16.00**	**16.00**	**16.00**



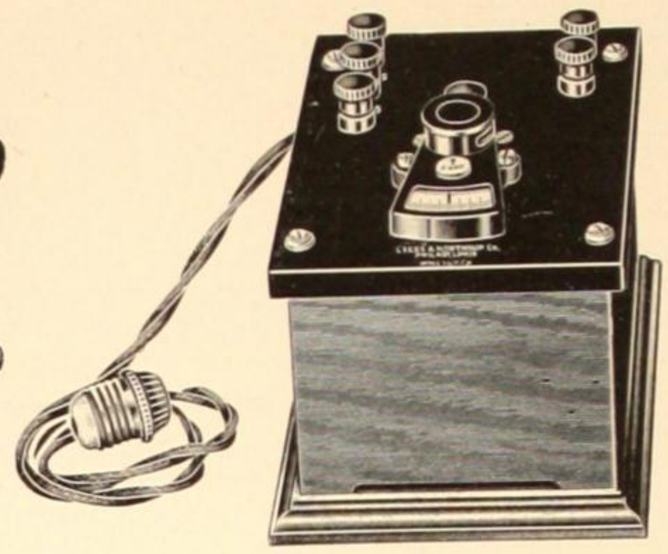
No. 2360E.



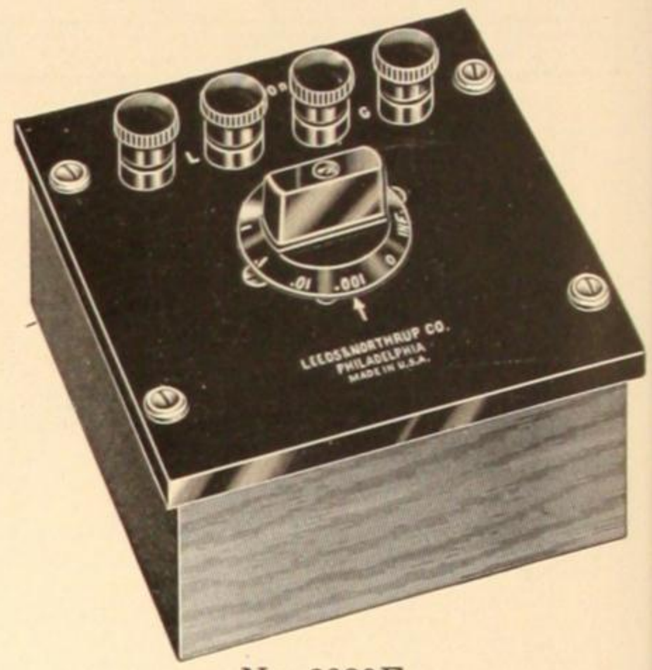
No. 2365E.



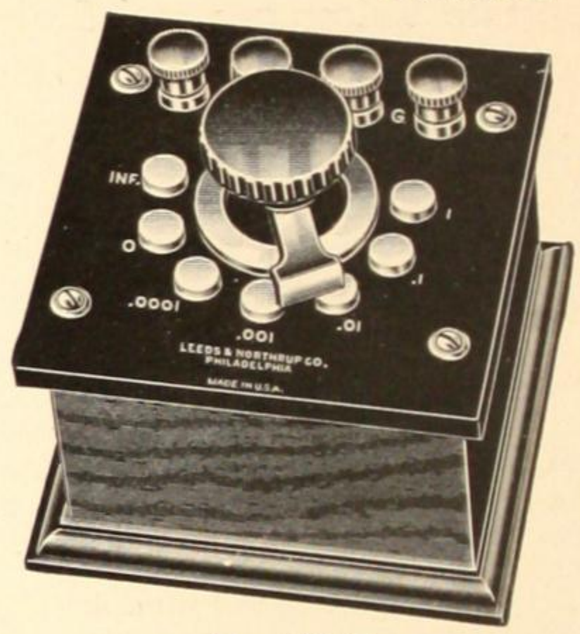
No. 2370E.



No. 2375E.



No. 2380E.



No. 2385E.

2370E. Galvanometers, Portable, Lamp and Scale Type, L. & N. These simple and rugged instruments have sufficient sensitivity for the large majority of laboratory bridge and potentiometer measurements. They are more robust than the ordinary pointer type instruments, just as convenient to use, and about twenty times more sensitive. The lamp and scale type of reading device will be found very convenient in some classes of lecture demonstrations and in bridge measurements involving numerous measurements by the zero method. The scale is made integral with the galvanometer system, is completely enclosed in a hardwood case, making the spot of light easy to read even in a fully lighted room. The scale has 25 mm. divisions each side of center zero. The lamp is of the 4-volt straight filament type and requires .5 amperes. Zero adjustment is provided by means of the large knurled head at the top of the system. Dimensions, 11.5x12.5x21.5 cm. To operate the lamp on an ordinary 110-volt lighting circuit, place an ordinary 16 c.p. carbon filament lamp in series in the lamp circuit. A 220 ohm resistance (see our Cat. No. 916E5) or rheostat (see our Cat. No. 922E4) also may be employed.

No.	A	B	C
Sensitivity, per mm. division, microamperes	0.05	——	0.025
Sensitivity, per mm. division, microvolts	——	25	——
Period, seconds	3	3	3
External critical damping resistance, ohms	10,000	80	15,000
Coil resistance, ohms	300	20	1,000
Each	**$40.00**	**40.00**	**40.00**

2375E. Galvanometer, A.C. Pointer Type, L. & N. The sensitivity of these instruments is ample to permit their use in alternating current bridges, potentiometers, and special set-ups.

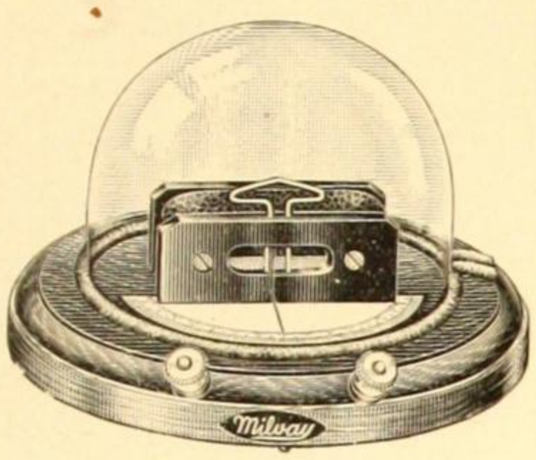
They are regularly used as "balance indicators" in testing sets for measuring the ratio and phase angle of instrument transformers and in alternating current bridges for measuring the conductivity of electrolytes. The scheme of connection is the same as that used in high sensitivity iron-core dynamometers. Mechanical zero adjustment is provided by the large bakelite knob at the top of the moving system. Magnetic zero adjustment is provided by a small knob back of the mechanical zero adjuster. When the mechanical and magnetic zeros have been made to coincide, these instruments are about as convenient to use on non-inductive circuits as No. 2360E D.C. Galvanometers. They are designed for operation on 110-volt. 60-cycle circuits. The field requires about .3 ampere at 110 volts, 60 cycles, and the power factor is about .15 so that the power consumption of the field circuit is approximately 5 watts. Mounted in polished mahogany case with grained bakelite top plate. Dimensions, 15.6x19x20 cm. Weight, 5 lbs. The Scale has 15 mm. divisions each side of center zero. Sensitivity per mm. division, 1 microampere; period, 3 seconds; coil resistance, 250 ohms.

Each **$60.00**

2380E. Shunt, Ayrton Universal, L. & N. This is a low priced switch type shunt, especially designed for student use. The total resistance is 10,000 ohms, equal to the critical damping resistance of No. 2285E Ballistic Galvanometer, which in the educational laboratory is ordinarily used for insulation resistance measurements. Mounted in a polished mahogany box with hard rubber top plate and insulated binding posts. Accuracy of adjustment 1% **$18.00**

2385E. Shunts, Ayrton Universal, L. & N. All are of the Ayrton type, so that the multiplying values are independent of the galvanometer resistance. All have the same positions: 1, .1, .01, .001, .0001, ZERO and INFINITY, but they vary in total resistance. In selecting a shunt, one of such resistance as to permit working with a galvanometer approximately critically damped, should be chosen. The resistance of the circuit beyond the shunt should be taken into account in making this selection, but, fortunately, in most work in which shunts are needed, such as insulation resistance, measurements and condenser measurements with ballistic galvanometer, the resistance beyond the shunt is practically infinite and may be neglected. The switch construction is of the substantial heavy duty type. Mounted in polished mahogany boxes, with polished hard rubber top plates. Dimensions, 13.5x8x13.5 cm. Weight, 3 lbs. Accuracy of adjustment, 1/10%.

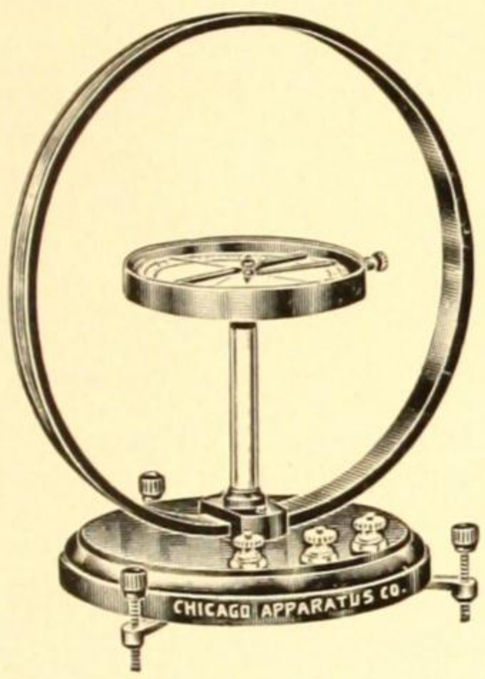
No.	A	B	C
Resistance, ohms	40,000	10,000	3,000
Each	**$35.00**	**27.50**	**25.00**



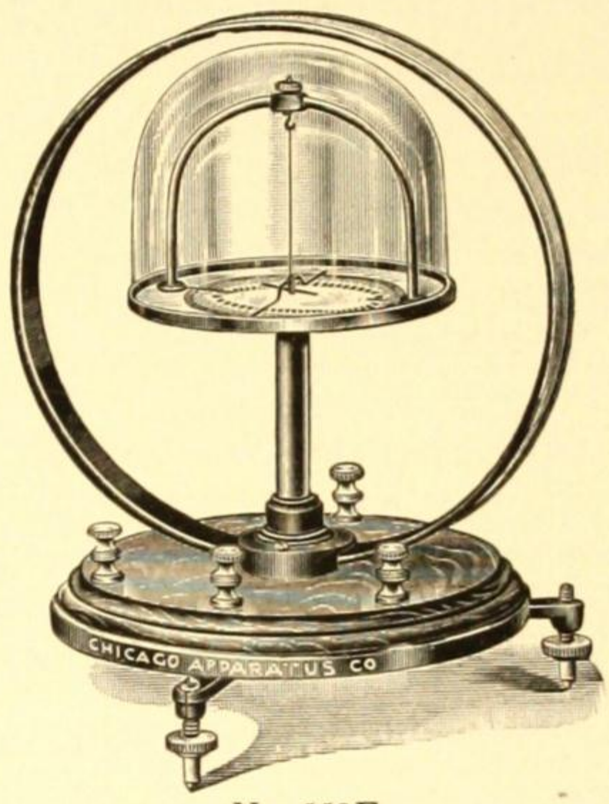
No. 543E.



No. 548E.



No. 553E.



No. 558E.

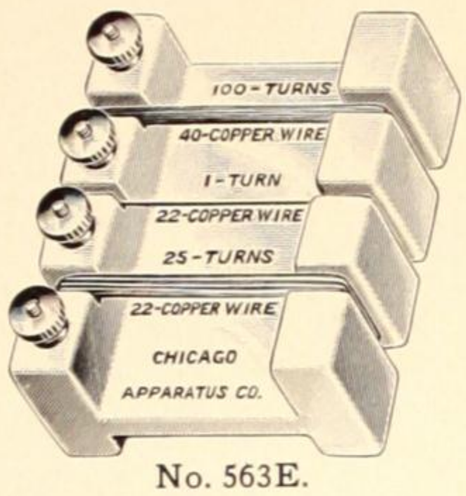
543E. Galvanometer, Detector Type. Excellent for use in elementary Wheatstone Bridge experiments, etc. Small currents are detected and indicated by this instrument. Needle with agate cap is delicately balanced. A removable stop is provided to prevent violent oscillations of the needle and to bring it to rest. Mounted on hardwood base 16 cm. in diameter, with glass shade **$7.50**

548E. Galvanometer, Tangent. Elementary form after Dr. Hall. Offers two advantages over older forms: A copper ring which unlike wood cannot warp, and a retaining rim which holds the compass in place. Designed so current can be sent through either 5, 10, or 15 turns of wire. On 10x15 cm. hardwood base. With No. 38M-40 mm. compass... **$4.50**

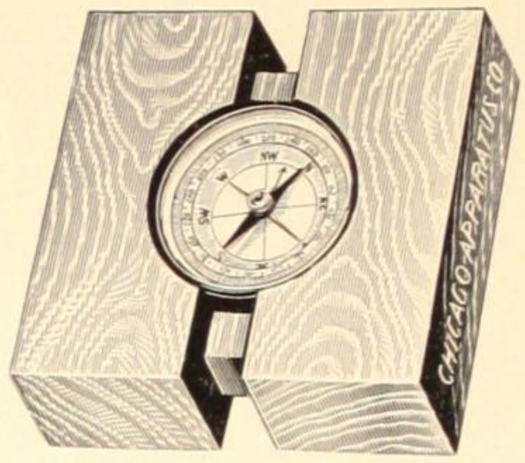
553E. Galvanometer, Tangent. A 22.5 cm. copper ring on a polished hardwood base with leveling screws. Agate capped needle, 20 mm. long, with aluminum indicator and stop, mounted in brass case with glass cover. Ring carries two coils of 5 to 10 turns No. 20 copper magnet wire, brought to three binding posts, so that either 5, 10 or 15 turns may be used **$12.00**

558E. Galvanometer, Tangent. Copper ring 25 cm. in diameter, mounted on a polished hardwood base with leveling screws. The needle is provided with a broad pointer to avoid parallax and is suspended from a silk fiber. The galvanometer box is mounted so that it can be turned to any desired position—makes accurate setting easy. The windings consist of 4, 50, and 500 turns brought out to convenient binding posts on the base. For heavy currents 4 turns are connected into the circuit; for small currents 50 or 500 turns are used..... **$17.50**

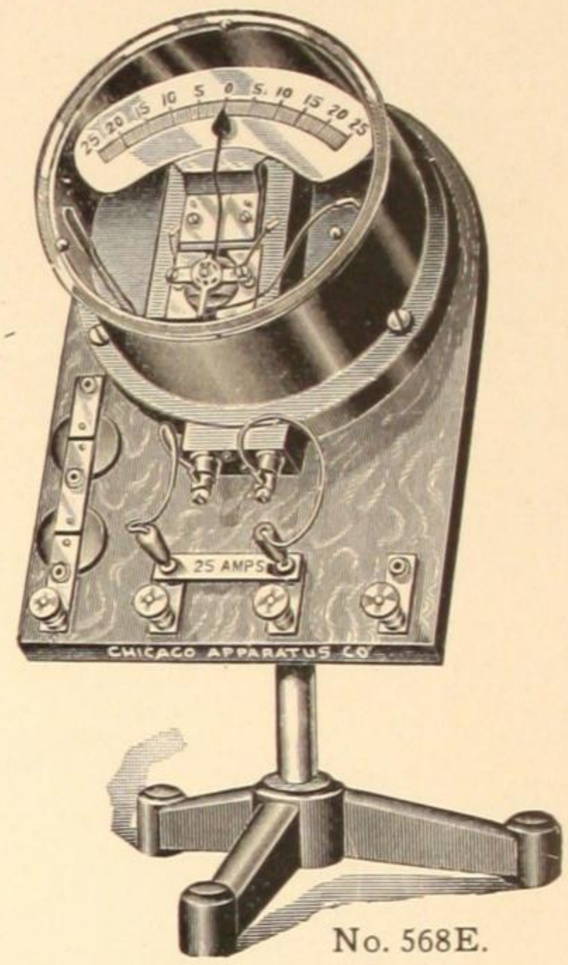
560E. Galvanometer, Tangent, Milvay. This high grade instrument is mounted on a finely finished hardwood base, rotatable on a brass tripod, each leg of which is equipped with a leveling screw. The ring, of solid brass, is 23 cm. in diameter and carries 300 turns of magnet wire so connected to a series of brass blocks on the base that 20, 40, 80 or 160 turns, or any combination thereof, may be connected into circuit by removing one or more of the four controlling plugs. In addition, the ring carries a band of heavy copper, for heavy currents, the terminals of which are connected to two binding posts at the rear. The dial, of finely finished metal, is engine-divided. The needle is properly proportioned and provided with an aluminum pointer with knife-edge ends to avoid parallax. Also, it has a jewelled center bearing to provide maximum freedom of motion. An externally controlled fork lifts and holds the needle off of its pivot when the instrument is not in use **$45.00**



No. 563E.



No. 564E.



No. 568E.

563E. Galvanoscope, Three-Winding. Millikan and Gale form. The wood frame employed for many years in the construction of this popular item has now been replaced by one of glazed porcelain. This improvement not only enhances the appearance, but also provides many other advantages. It is acid and moisture proof. It does not warp. It is proof against scratches and wear, and because of its substantial proportions is also proof against breakage.

It has the regulation three coils of 1, 25 and 100 turns of enameled copper wire. The number of turns and gauge of wire in each coil are permanently molded in the porcelain, as shown in the illustration. Binding posts are arranged so that each coil may be used separately. In this type of galvanoscope variation of sensitivity is accomplished by merely changing the distance between the coil in circuit and the compass.

Four felt feet cemented into sockets in the base make it possible to use this galvanoscope safely on the most highly finished table tops. Either our Nos. 43M or 48M Compass yields satisfactory results.

Size, 10.8x8.2x4.1 cm. Weight, 500 grams. Without compass **$1.75**

564E. Galvanoscope Block with Compass, Fountain's. To be wound by the student with as many turns of wire as dictated by experimental requirements. Grooved wooden block fitted with No. 53M Compass. Without wire or binding posts..... **$1.25**

Compasses for use with this galvanometer are listed in Magnetism Section.

568E. Galvanometer-Volt-Ammeter, Jewell-Milvay, Accuracy—1%. This general utility instrument is admirably adapted for general laboratory and lecture work in colleges, electrical schools, technical schools, vocational schools, and high schools. It has six ranges, two for current and four for voltage. Any range is made instantly available by merely inserting the tips of the flexible leads into the proper sockets. It is also valuable as a low sensitivity lecture galvanometer. In this work the zero center scale is a decided advantage as reversal of current flow can be shown without changing connections. Thus it is well adapted for showing the character of the low frequency A. C. current generated by a simple hand operated dynamo like our No. 387E and in experiments on induced currents. Ranges are as follows:

D.C. Current Ranges

1. **Milliammeter.** Range 25-0-25 M.A. in 1-M.A. divisions.
2. **Ammeter.** Range 25-0-25 Amperes in 1-A. divisions.

D.C. Voltage Ranges

3. **Millivoltmeter.** Range 25-0-25 M.V. in 1-M.V. divisions.
4. **Voltmeter.** Range 5-0-5 Volts in 1/5 V. divisions.
5. **Voltmeter.** Range 25-0-25 Volts in 1-V. divisions.
6. **Voltmeter.** Range 125-0-125 Volts in 5-V. divisions.

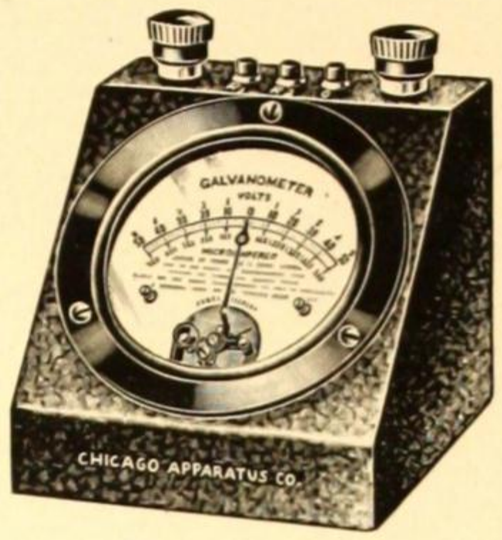
Galvanometer

7. **Sensitivity,** one scale division deflection for 1 volt through 1000 ohms.

The base is cast aluminum and on it are mounted shunts and resistances for the various ranges. The movement is an extra fine Jewell D'Arsonval and is mounted in a 7-inch diameter metal case, the inside of which is finished in snow-white enamel. Against this white background every detail of the movement can be viewed to advantage through the plate glass cover. Likewise, all circuits can be traced and the principles of meter construction studied. A zero corrector of the external control type is provided. The tripod mounting is such that the instrument can be quickly adjusted to three different positions, vertical, horizontal and at an angle of 45 degrees. No other instrument offers the ranges and advantages found in this popular combination galvanometer-meter. **$49.50**



No. 574E.



No. 575E.

574E. Galvanometer, D'Arsonval, Portable, Milvay, with Self-Contained Protecting Shunt. The use of this shunt, which can be instantly switched into or out of circuit by means of the two push buttons, protects the movement from damage which might otherwise result from excessive current. Depressing the first button switches the shunt into circuit and reduces the sensibility to approximately one-tenth and and at the same time makes the movement absolutely dead-beat. This is of great advantage in Wheatstone Bridge work, as it makes it possible to secure an approximate balance with much greater rapidity. Depressing the second button automatically returns the first button to its original position and switches the shunt out of circuit, thus allowing the full sensitivity—a deflection of one scale division for one volt through 150,000 ohms—to be utilized. The fact that the buttons stay down will be found a great convenience as it makes it possible to use the instrument continuously either as a high or low sensitivity instrument without the necessity of constantly keeping the fingers on the buttons. The buttons are conveniently located below the movement where they are more easily accessible and out of the way of the binding posts and connecting wires. This instrument is also larger than others of this type. The base measures 106x112 mm. It may therefore be used in many lecture table experiments as well as in students' experiments, for which it was primarily designed **$13.50**

575E. Galvanometer, Portable, Three-Button Calibrated Type. In its original uncalibrated form, this instrument with its button-controlled protective circuits was admirably adapted to many kinds of laboratory uses, such as "zero indicator" in bridge measurements, current detector and direction of current flow indicator in induction and dynamo output circuits, etc. Its protective circuits provided the three ranges of sensitivity best suited to the needs of a wide range of experimental circuits. None of these advantages have been lost in calibrating the control circuits of the present model, but on the contrary, the usefulness of the instrument has been greatly extended, so that now it may also be used for making precise current and voltage measurements.

Thus, when button "R2" is depressed, it becomes a voltmeter with a range of 5-0-5 volts in 1/10-volt divisions. When button "R1" is down it becomes a millivoltmeter with a range of 100-0-100 M.V. in 2 M.V. divisions. And, when button "O" is down it becomes a microammeter (or sensitive galvanometer) with a range of 500-0-500 M.A. in 20 M.A. divisions. By using the shunts and resistors listed below many additional ranges can be provided.

The movement is of the pivoted D'Arsonval type and is mounted as illustrated, in a metal case finished in crystal black. The scale reads in units from 50-0-50 and the graduations are 1 millimeter apart, making it easy to estimate fractions of a division. Overall dimensions are 3¾x4x4 inches and the guaranteed accuracy is 2% **$15.00**

576E. Ammeter Shunts. For use with No. 575E without further adjustment or calibration. Their use provides additional ammeter ranges. Adjustment is for 100 M.V. drop.

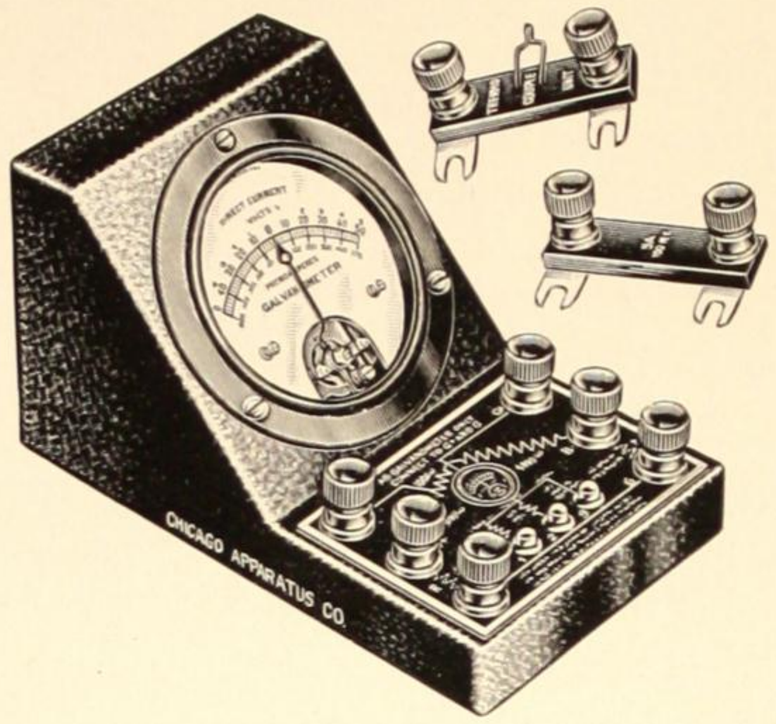
No.	A	B	C	D	E	F
Range in amps..	0.05	0.5	1	5	10	25
Value per scale Div., amps....	1/1000	1/100	1/50	1/10	1/5	1/2
Each	**$2.50**	**2.50**	**2.50**	**2.50**	**2.50**	**2.50**

577E. Voltmeter Resistor, Single Range. For use with No. 575E without further adjustment or calibration. Its use provides an additional voltmeter range of 50-0-50 volts in 1-volt divisions..... **$4.00**

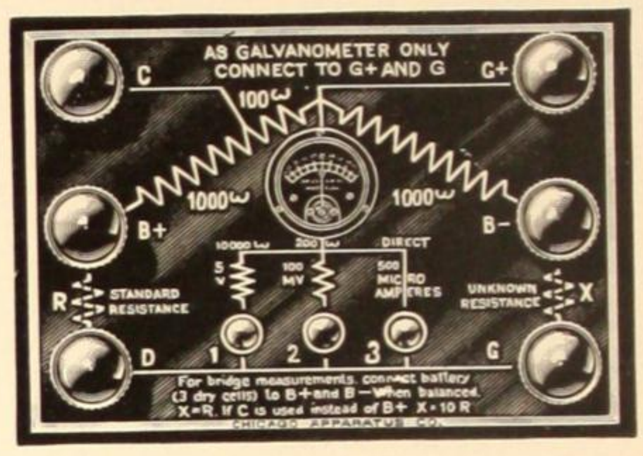
578E. Voltmeter Resistor, Double Range. Same as No. 577E, but providing two additional voltmeter ranges: 50-0-50 volts in 1-volt divisions, and 250-0-250 volts in 5-volt divisions..... **$15.00**

579E. Thermocouple. A copper-nickel couple on suitable mount for connection to No. 575E. Convenient for demonstrating thermoelectric effect. **$2.50**

Jewell Galvanometer and Wheatstone Bridge Combined



Nos. 2390E-2410E-2395E.



Base plate of No. 2390E showing simplicity and ease with which connections may be traced even while the instrument is in use. A great advantage.

This new instrument consists of a fine portable D'Arsonval galvanometer so mounted and connected that it may be used for the following nine useful laboratory purposes:

1. **Three Button Galvanometer.** Maximum sensitivity (No. 3 button down), 20-microamperes per division deflection—equal to 1 volt through 50,000 ohms.

2. **Wheatstone Bridge.** Two dry cells are connected across posts "B— and B+"; resistance box across posts "R," unknown resistance across posts "X." With galvanometer in balance "X" will equal "R." In addition bridge arm ratios of 10 to 1 and 1 to 10 are provided.

3. **Microammeter.** Range (No. 3 button down), 500 microamperes in 20 microampere divisions each side of the center zero.

4. **Millivoltmeter.** Range (No. 2 button down), 100 millivolts in 4 millivolt divisions each side of the center zero.

5. **Voltmeter.** Range (No. 1 button down), 5 volts in 1/5 volt divisions each side of center zero. Resistors for extending the range to 50 and 250 volts are listed below.

6. **Ammeter.** Ranges of .05 to 25 amperes are available by the use of shunts listed below. These must be connected across posts G+ and G, and No. 2 button depressed.

7. **Thermo-electric Indicator.** By heating the junction of the thermocouple listed below, after it has been connected between posts G+ and G, a deflection effect will be noted on the scale. This illustrates the principle of the electric pyrometer used in measuring furnace and other high temperatures.

8. **Polarity Indicator.** With circuit terminals connected to G+ and G, a pointer deflection to the right of zero indicates that the terminal at G+ is positive; if deflection is to the left this terminal is negative.

The scale has 25 divisions each side of the center zero and carries three sets of figures: 5-0-5, 50-0-50, and 500-0-500, for convenience in reading deflections when the instrument is used as voltmeter, galvanometer, microammeter, etc. Scale length is 2½ inches or 62 mm. Weight, 36 ounces; size 6⅝x4x3¾ inches.

2390E. Galvanometer and Wheatstone Bridge, Jewell. As illustrated and described.....**$22.00**

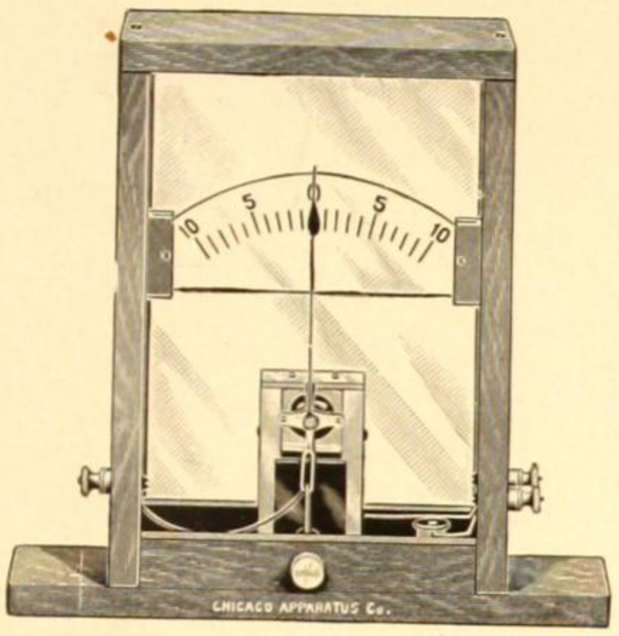
2395E. Ammeter Shunts. When one of these shunts is placed across posts G+ and G, it converts No. 2390E into an ammeter with a range each side of center zero corresponding to the shunt rating. The rating is marked on each shunt to avoid confusion where two or more are kept available. The adjustment is for 100 M.V. drop which is the drop when button No. 2 is down.

No.	A	B	C	D	E	F
Rating, amperes	0.05	0.5	1	5	10	25
Each	**$2.50**	**2.50**	**2.50**	**2.50**	**2.50**	**2.50**

2400E. Voltmeter Resistor, Single Range. Connected to posts G+ extends range to 50 volts each side of center zero. Resistance equals 2000 ohms per volt.....**$4.00**

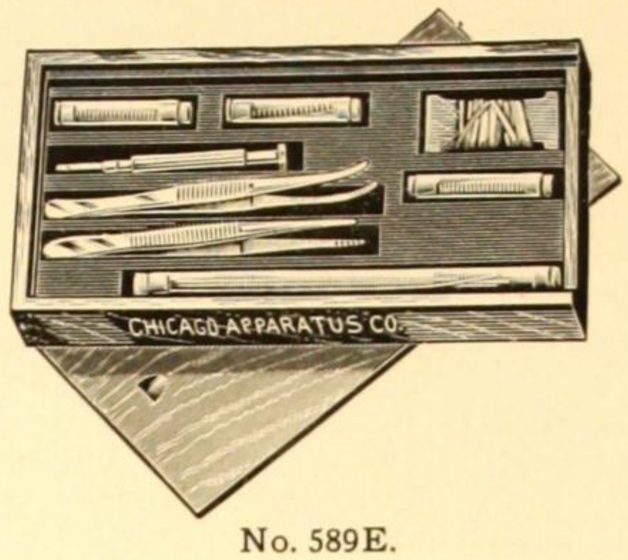
2405E. Voltmeter Resistor, Double Range. Same as 2400E but for voltmeter ranges of 50 and 250 volts. Resistances equal 2000 ohms per volt.....**$15.00**

2410E. Thermocouple. Copper and nickel couple mounted on insulating strip with binding posts.**$2.50**

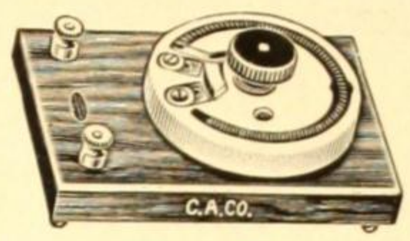


No.580E.

580E. Galvanometer, Milvay, Lecture Table. The pivoted-coil construction employed in this new instrument is a guarantee that it will give longer, better, and more dependable service than the old suspension type which we have discontinued. The fact that in the other type the suspension is overloaded with a coil having two pointers of the target type is an inherent weakness. As a result, suspensions break frequently and unless the coil is securely locked, the targets and the pointers get badly bent when the instrument is moved about. In the pivoted-coil type, there are no suspensions to break, no pointers to get bent out of shape. Because of the fine movement employed, the sensitivity of the present model is sufficiently high for all ordinary lecture work. This is indicated by the fact that one volt through 40,000 ohms gives a deflection of one scale division or 5 mm. Passing an ordinary 6-inch bar magnet through an Induced Current Coil, like our No. 298E, produces a deflection of 7 to 8 divisions. Used with our No. 793E Primary and Secondary Coil practically full scale deflections result in all experiments. Being very responsive, the pointer will follow the alternations of the current delivered by our No. 386E Simple Dynamo. Its usefulness is further extended by providing two sensitivity ranges. Connecting to one binding post on the right, places the movement directly into circuit making available the full sensitivity of the instrument. In series with the other binding post, and inside of the case, is a resistance coil which reduces the sensitivity to approximately 1/10 when connection is made to this post. The pointer can always be set instantly to zero by the external-control type corrector at the lower front center. The scale has ten large divisions (5 mm. wide) each side of the center zero. Both divisions and figures are "Bold Face," therefore legible at a distance from the lecture table. The scale carries the same graduations and figures on both sides. A target pointer for distance reading swings over one side of the scale while a continuation of this pointer in the knife-edge form moves over the other side. This arrangement makes it possible for both students and teacher to note or read deflections with equal ease, a decided advantage in lecture work. The instrument is enclosed in a finely finished wooden case with large front and back glass plates to provide maximum illumination. It stands 25.5 cm. high. The open and exposed construction makes possible the study of the D'Arsonval movement, which type is employed in practically all D.C. ammeters and voltmeters. By employing high series resistances or low shunt resistances, and adjusting them to known current values, the instrument may be calibrated into a voltmeter or ammeter of moderate accuracy. In this way, the principles of electrical meters, which are nothing more than calibrated moving-coil galvanometers, can be shown to good advantage **$20.00**



No. 589E.



No. 593E.

589E. Galvanometer Repair Kit. A complete outfit for making repairs on all types of suspension galvanometers. Consists of three coiled phosphor-bronze lower suspensions in separate glass tubes; six phosphor-bronze upper suspensions in one glass tube; one card of unspun silk fiber suspension; one fine curved forceps; one blunt straight forceps; and one small jeweler's screw driver. Complete in compartment box **$4.00**

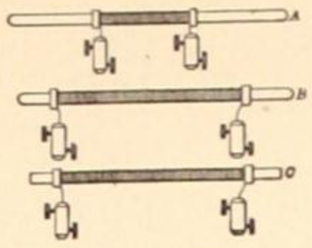
593E. Galvanometer Shunt, Adjustable. A rheostat coil, well insulated and mounted upon a 10x15 cm. hardwood base with binding posts provided with a sliding lever by means of which the resistance may be varied from 0 to 10 ohms. When the maximum resistance (10 ohms) is shunted across No. 529E Galvanometer (resistance 200 ohms) it reduces the sensibility to one-twentieth; when shunted across No. 523E Galvanometer (resistance 100 ohms) it reduces the sensibility to one-tenth. A smaller shunt resistance causes a proportionately larger reduction in sensibility **$3.00**

594E. Galvanometer Shunt, Variable. Consists of a maganin rod mounted between brass end posts on a bakelite base, and provided with two sliding terminals to provide any desired resistance value within the range of the manganin rod from 0 to .01 ohm. To fix their position and to insure good contact, the sliding terminals are provided with lock screws. **$5.00**

596E. Galvanometer Suspension, Fiber. Unspun silk, as used in Nos. 518E and 558E Galvanometers. 10 yards wound on card..... **Per card $0.25**

598E. Galvanometer Suspension, Lower. Copper, spiral form, as used on Nos. 523E, 529E and 533E Galvanometers ..... **Each $0.25**

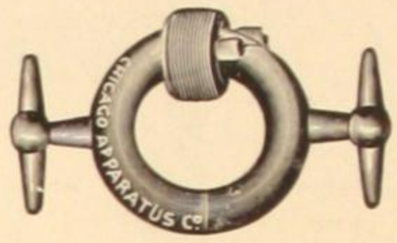
604E. Galvanometer Suspension, Upper. Phosphor-bronze ribbon .0007x.0125 inch, as used in Nos. 523E, 529E and 533E Galvanometers. 5 feet wound on card ..... **Per card $0.50**



No. 608E.



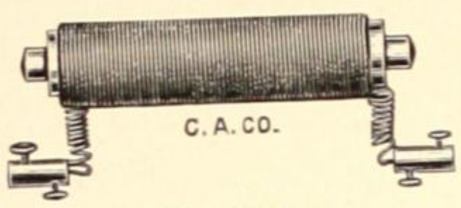
No. 613E.



No. 618E.



No. 623E.



No. 628E.



No. 2415E.



No. 633E.

608E. Helices, Set of Three. As used in Fuller and Brownlee's Course. Coils A and B are wound on 20x1 cm. soft iron cores; one has 50 turns of wire, the other 100 turns. Coil C is wound on a wooden rod and has 100 turns. Each helix is provided with two brass connectors.
Per set $2.00

613E. Helix and Cell, Floating. With this combination, which will float upright in water, the magnetic polarity of an electro-magnetic solenoid can be readily shown. When floated with a battery solution in the small jar in the center of the cork disc, the solenoid will act the same as a magnetic needle, one end developing South and other end North polarity. Length of helix, 5 inches..... $2.25

618E. Helix and Ring. (Magic Circle.) Two semicircles of soft iron with large handles and helix of insulated copper wire. Outside diameter, 90 mm. $2.50

623E. Helix or Solenoid. Simple open form, mounted on a fiber strip. Length, 12.5 cm.; diameter, 25 mm. With two brass connectors and soft iron core 15 cm. x 13 mm. $1.50

628E. Helix or Solenoid. Wound on a metal tube and therefore very durable. Length, 12.5 cm.; diameter, 30 mm. With soft iron core 15 cm. x 13 mm. and two brass connectors $1.50

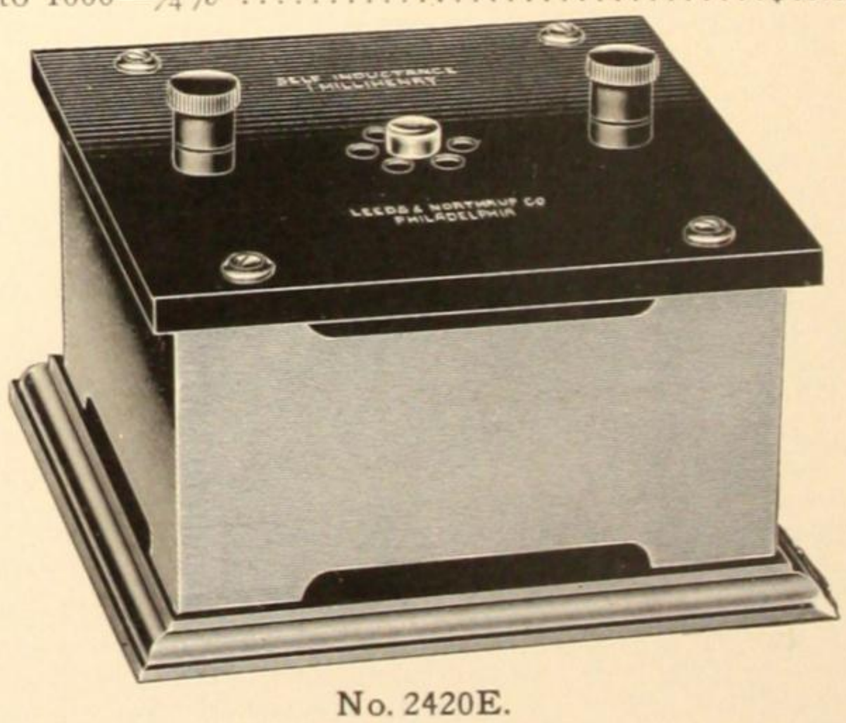
633E. Helix or Solenoid. Same as No. 628E, but mounted on a stand 20 cm. high with 10x15 cm. hardwood base. With this form small nails, etc., suspended from the ends of the core can be clearly seen by the students. With soft iron core 15 cm. x 13 mm. $3.50

2415E. Coil, Self-Induction. For finding the coefficient of self-induction of a coil as outlined in experiment No. 14 in Millikan and Mill's "Electricity, Sound and Light," and in experiment No. 36 in Taylor, Watson and Howe's "General Physics for the Laboratory." Contains 3000 turns of No. 28 insulated copper wire wound on a spool mounted on a wooden base, 15 cm. in diameter, with binding posts. The coil is 7.5 cm. in diameter and 10 cm. high. Approximate inductance, 250 millihenries. $8.00

2420E. Inductance Standards, Fixed, L. & N.
These standards offer a distinct advantage over those available previously, in that they are wound in toroidal form. This makes them practically immune from stray field errors and prevents their setting up external fields which might affect other apparatus.
In order to make these standards useful for measurements at 1000 cycles, as well as for measurements at the lower frequencies, the windings are made up of wire having such a small cross-section that there is no appreciable increases in resistance when used at 1000 cycles.
The approximate time constant (ratio of inductance to resistance) is 1 x 10^{-3}. Mounted in a substantial, ventilated mahogany case with bakelite top plate. Accuracy, ¼% at 1000 cycles.

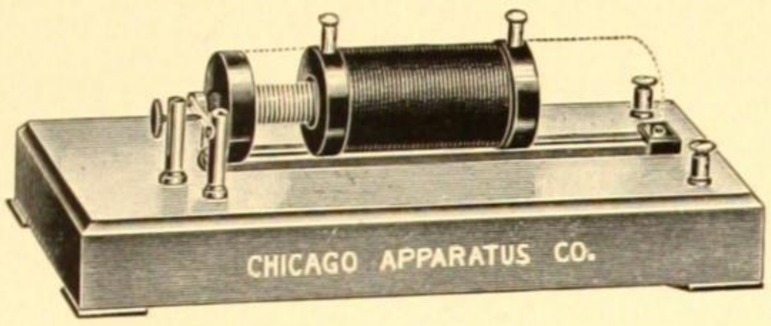
No.	A	B	C	D
Self inductance, millihenries	1	10	100	1000
Continuous current cap., amperes	1	.5	.15	.05
Each	$30.00	30.00	30.00	30.00

2425E. Inductance Standard, Fixed, L. & N. A 50 millihenry standard of mutual inductance, similar to the self-inductance standards listed above, but provided with four binding posts. Continuous current capacity, .15 amperes. Accuracy for frequencies up to 1000—¼% $40.00

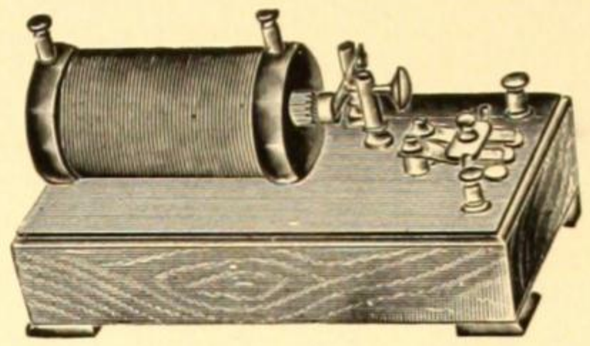


No. 2420E.

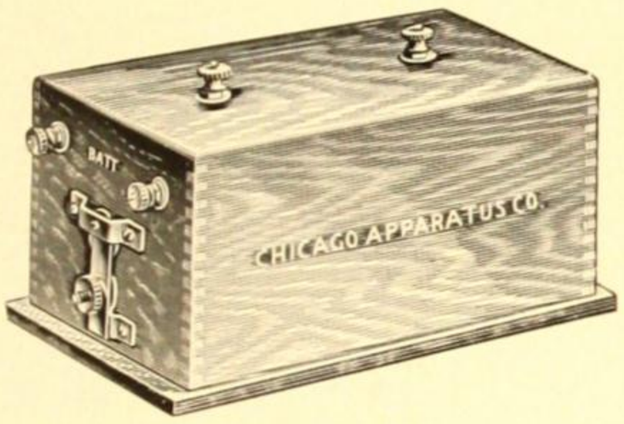
Induction Coils



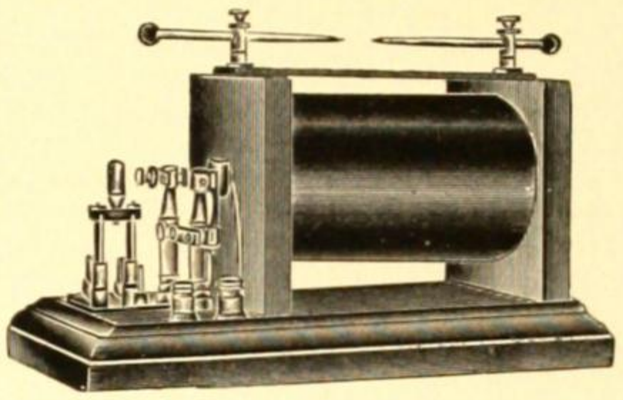
No. 638E.



No. 643E.



No. 650E.



No. 653E.

638E. Induction Coils. Demonstration form, with sliding secondary, on polished mahogany box with condenser; spark length, 6 mm..... **$7.00**

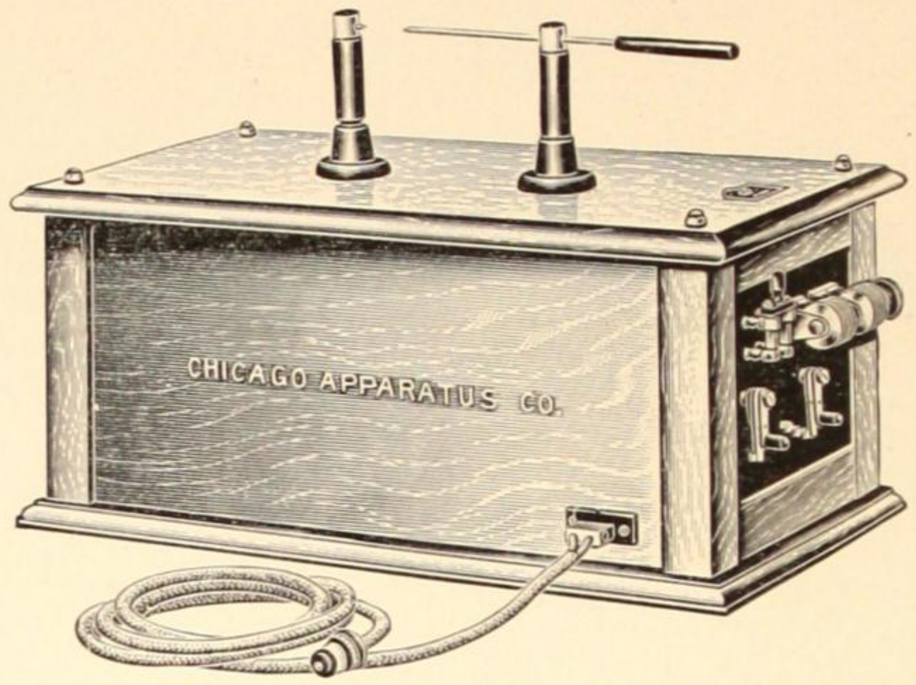
643E. Induction Coils. Mounted on finely polished mahogany box, with commutator, condenser and adjustable vibrator or interrupter. Any of these coils will operate on the low voltage battery current produced by one to three cells. These coils are strictly high grade and guaranteed to give splendid results and long service.

Cat. No.	643E	645E	647E
Spark, length, mm.	6	13	25
Each	**$8.00**	**12.00**	**21.00**

650E. Induction Coil, 1-inch Spark. A rugged, low-priced coil that will give complete satisfaction in the operation of Geissler Tubes, Spectrum Tubes, Wireless Transmitters, Spark timers, etc. Yields a heavy crashing spark 1 inch long when operated on a 6-volt storage battery or 5 to 6 dry cells. The primary and secondary coils are section-wound and imbedded in an insulating compound which completely fills the inside of the case. The vibrator is adjustable and the heavy breaker points are shunted by a condenser to prevent excessive arcing. The secondary terminals, 3.5 inches apart, are located on top; the terminals for the current supply on the same end as the vibrator. The case is of finely finished oak and measures 21.5x10.5x12 cm. Metal parts are of brass..... **$9.00**

653E. Induction Coils. Equipped with mechanical circuit breaker mounted independently on a heavy block of slate. The rigidity of this construction increases the efficiency of the coil. The secondaries are built in sections, each section being wound in layers. Three means of adjustment are provided, allowing a wide range of regulation—3 to 100 vibration per second. This makes the coil adaptable to a large variety of work. A double pole, double throw knife switch for reversing the direction of the primary current is mounted on the base. All operate on low voltage battery circuits, the 150 mm. coil delivering its maximum spark with an input of only 6 amperes at 4 volts (24 watts); the smaller coils take proportionately less.

Cat. No.	653E	654E
Spark, length, mm.	75	150
Each	**$50.00**	**85.00**



No. 656E.

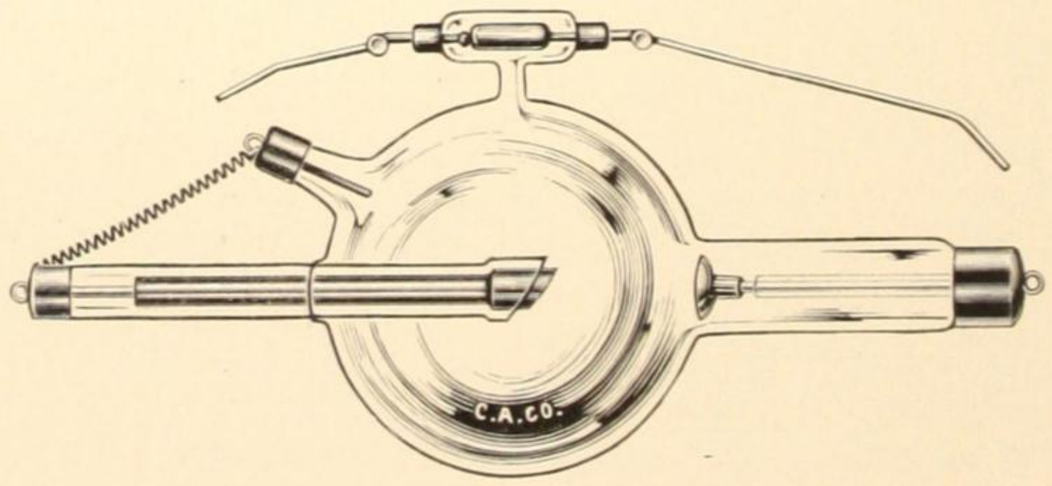
656E. Induction Coil, 110-Volt A.C. operated, X-Ray and Demonstration Type. Made especially for us by a leading manufacturer of medical X-Ray equipment. If a Tungsten Target tube of the type listed under No. 545F is employed, X-Rays of sufficient penetration are produced so that the bony structure of the Hand, Wrist, Elbow, Foot, Ankle, Upper Arm, Knee, Shoulder, Head, Chest, and Spine may be examined with a fluoroscope or photographed on suitable plates. In photographic work the exposures vary from 1 second for the Hand to 20 seconds for the Spine.

Upon a Bakelite panel at one end of the coil the following controls are mounted. Main switch for opening and closing the primary circuit. Tungsten Interrupter Points with adjusting knob for regulating the frequency and current flow. The points are equipped with copper flanges for air cooling. Rheostat lever for regulating the current flow through the tube. Frequency lever for regulating the frequency from Violet Rays to X-Rays.

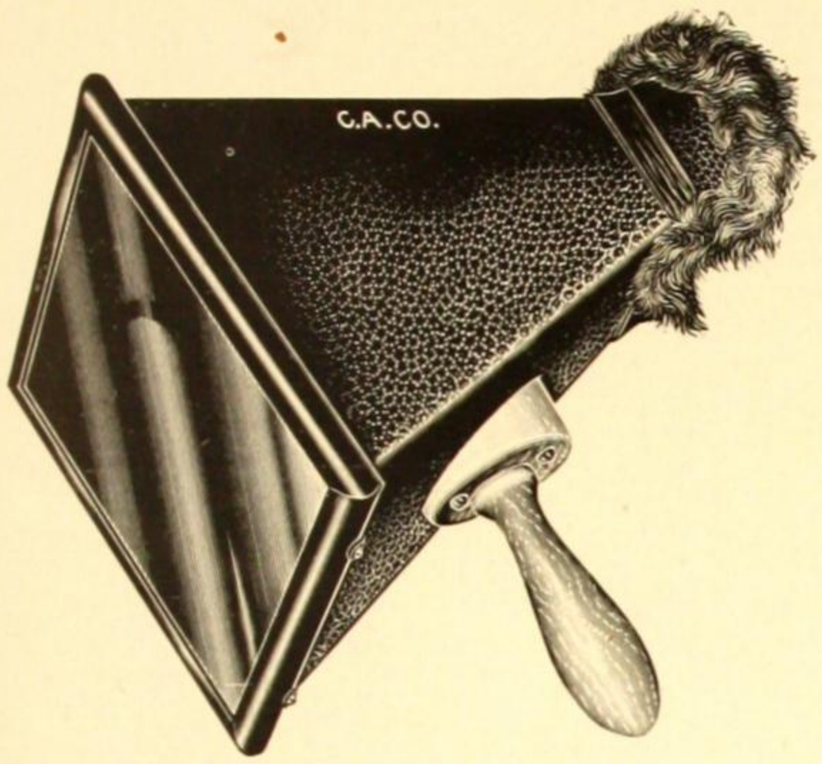
The secondary terminals are mounted on insulating pillars, approximately 5 inches high. One terminal is a fixed point; the other, provided with insulating handle, is rotatable about the pillar as an axis. The maximum spark gap is about seven inches, and when the coil is operating at capacity a series of heavy sparks will jump across this gap, producing the sharp crackling noises characteristic of high-tension jump discharges.

The coil is designed to operate directly on a 110-volt A.C. circuit and has a maximum current draw of 16 amperes. The primary and secondary windings are embedded in insulating wax and enclosed in a finely mahogany-finished case. Length 26 inches, width 16 inches and height, exclusive of secondary pillars, 17 inches. Complete with seven-foot detachable cord provided with two-piece attachment plug and full directions **$125.00**

545F. X-Ray Tube, Tungsten Target Type, 6-inch Diameter. Especially pumped for use with our No. 654E or 656E X-Ray Coil. Remains cooler and maintains a more constant vacuum than tubes of smaller diameter. Also for these reasons it will not require vacuum reduction treatment as frequently as the smaller sizes. The chamber to which the long slender wire terminal is attached is filled with asbestos, treated with a chemical which vaporizes into a gas by the passage of a current. By adjusting the slender wire so that its terminal is within one inch of the cathode terminal and passing a spark for a second or two the internal resistance of the tube is lowered. This reducing treatment is only necessary when the vacuum in the tube becomes too high, as it will after considerable use. This heavy Tungsten target type tube is identically the same as that used in professional medical work where results and service are paramount to a small difference in cost **$38.50**



No. 545F.



No. 146F.



No. 657E.

146F. Fluoroscope, Professional Type. The brilliant results obtained in X-Ray examinations with this fluoroscope are due to the remarkable characteristics of its screen: 1. The fluorescent salt from which the screen is made is an absolutely stable chemical combination and is not affected by heat or dampness, by the continual bombardment of X-Rays, or by pressure. It does not deteriorate with age, like the barium platinum-cyanide screens so quickly do. 2. The light emitted by this screen is brilliantly white. The images therefore present black and white contrasts which are pleasing to the eye. 3. The screen is free from visible grain. This is a most important attribute as it assures images with sharp clean-cut outlines. 4. It has absolutely no phosphorescent afterglow or lag. This quality prevents blurred outlines when examining moving objects.

Expert Roentgenologists use this type regularly for the fluoroscopic examination of fractured bones, etc. Used with our No. 656E Induction Coil and No. 545F X-Ray Tube, because of the penetrating X-Rays produced by this equipment, this fluoroscope reveals the bony structure of the Hand, Wrist, Elbow, Foot, Ankle, Knee, etc., with a contrast, sharpness, and clearness impossible with calcium tungstate or barium - platinum - cyanide - screen - equipped fluoroscopes. The screen, 5x7 inches, is covered by a glass plate on the inside to protect it from dust and is readily removable for examination or replacement. It is mounted in a finely finished box with handle and fur-lined eyepiece.....**$26.50**

657E. High Frequency Tesla-Type Coil. Operates directly on 110 volts A.C. or D.C. without the use of rheostats. Produces a stream of high potential, high frequency sparks, about 2 inches long, that pass out continuously from the metal tip into the surrounding air or to nearby objects of metal. Consists of a special Tesla type high frequency generator with one secondary terminal connected to a long pointed metal tip. At the opposite end is a six-foot cord with plug and a screw for quickly adjusting the discharge to maximum. The entire unit is enclosed in a black bakelite cylindrical shell. Because of the high insulating quality of the latter, no discharge can escape except by way of the metal tip. Therefore, the coil can be safely handled and its discharge directed to wherever desired. It is this portable feature, together with its fine performance, that makes it ideal for many laboratory and demonstration purposes. A few of its more important uses are:

Exciting Vacuum Discharge Tubes. It will operate practically every type of vacuum tube—Geissler, spectrum, aurora, Holtz, Hittorf, shadow cross, fluorescent, phosphorescent, etc. Most tubes will exhibit all their characteristics—glow light, fluorescence, phosphorescence, etc.—when the metal tip of the coil is brought to within several inches of either of its terminals. In some cases it may be necessary to bring the tip into actual contact with the terminal to secure the best effects. Then too, the second terminal may be grounded by attaching a chain or wire and allowing the free end to touch the table top. In any event the best method can always be quickly found by trial. The full beauty of tube effects is of course always revealed to the best advantage in the dark.

Exciting Vacuum Tubes in a High Potential, High Frequency Field. Insulating Stands No. 3105E with Screens No. 3115E mounted upon them are separated about ten inches, the screens being parallel to each other. One stand is grounded by attaching to its hook a chain or wire, the free end of the latter touching the table top. When the metal tip of the coil is brought into contact with the hook of the other stand, a high potential, high frequency field is set up between the screens. And, when any vacuum tube is brought into this field, it glows, fluoresces, and phosphoresces even though there is no connection of any kind to the terminals of the tube. Since a neon tube (our No. 3155E or No. 338F) is extremely sensitive to high tension fields, it may be used to explore the extent of the field between and around the screens. When the Electrodeless Tube No. 3155E is employed the effect produced is striking in the extreme.

Detection of Leaks in Glass Vacuum Lines and Vessels. The tip of the coil is moved along the tube or vessel to be examined, and at the point of puncture, the spark will pass through the minute hole in the glass wall, producing a distinct yellow glow. Workers in research laboratories and manufacturers of incandescent lamps, radio tubes, x-ray tubes, neon signs, vacuum bottles, etc., have used this method of locating leaks in vacuum systems and vessels with great success for many years.

Other uses for this portable high tension generator will readily suggest themselves, once the operator has become familiar with its performance. Overall size, about 5x27 cm. Complete with cord and plug **$15.00**

Tesla High Frequency Coil

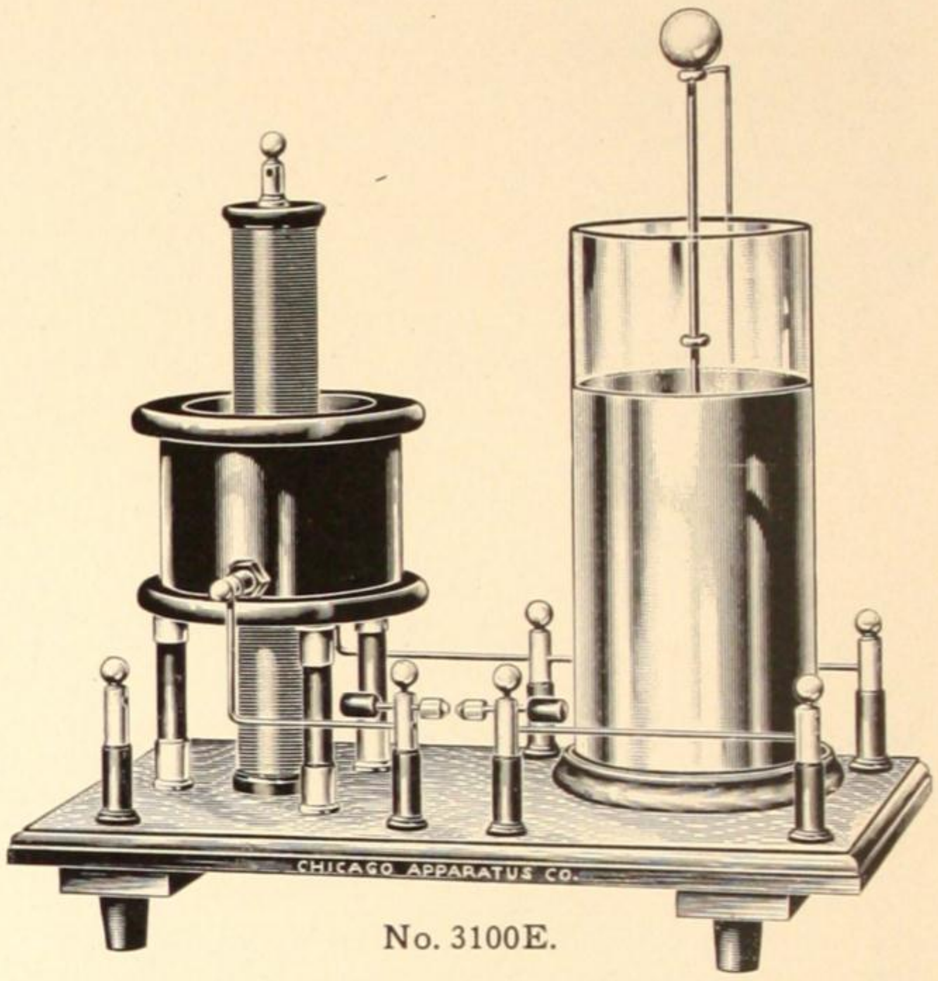
3100E. Tesla High Frequency Coil or Oscillation Transformer, Milvay. For generating high frequency and high voltage currents with which many spectacular demonstrations can be made. The apparatus consists of a primary coil, having a few turns of heavy copper wire, connected in series with a Leyden jar and an adjustable zinc spark-gap. Coaxially within the primary coil is a secondary coil having a large number of turns of fine wire brought out to two large brass terminals with ball-topped screws. One of these terminals is located at the top of the coil, the other on an insulating pillar in a near-by corner of the base. The primary coil is enclosed in an insulating housing, and the connections from this coil to Leyden jar and spark-gap are heavy brass rods elevated on tall insulating posts, a construction which entirely prevents leakage of the high tension currents flowing through this circuit.

In use, the secondary terminals of an induction coil with a spark output of 3 to 6 inches (Our No. 653E or 654E) or of a transformer (Our No. 1039E) is connected to the primary terminals of the Tesla Coil. This produces a succession of spark at the zinc spark-gap, each spark giving rise to a group of high frequency oscillations in the secondary windings, resulting in remarkable brush discharge and other effects at the secondary terminals. The extremely high potential in the secondary of the Tesla Coil is the result of the superposition of two oscillations having the same amplitude but differing in frequency. The gap yielding the best results for a given spark input is quickly found by trial.

Some of the spectacular demonstrations possible with this apparatus are:

Brush Discharge Between Concentric Rings. The secondary terminals of the Tesla Coil are connected, by chains or wires, with the hooks of No. 3105E Insulating Supports on which are surmounted No. 3110E Rings. The stands are shifted to bring the smaller ring concentrically into the plane of the larger ring which measures about six inches in diameter. On exciting the Tesla Coil, numerous heavy sparks will crash through the air between the rings. As the rings are moved 3 to 4 inches apart, the heavier sparks fade into a brush discharge which completely surrounds both rings and fills the space between them with myriads of reddish streamers and a beautiful reddish-violet glow light. The effect demonstrates the exceptionally high potential output of the Tesla Coil in a manner that is impressive and striking in the extreme. The effect is accompanied by the production of a tremendous volume of ozone.

Brush Discharges Between Parallel Rods. The rings are replaced by No. 3110E Rods. The stands are shifted so that the rods form a gap several inches wide. If the gap is parallel numerous heavy sparks will dance between the rods. As the size of the gap is increased, the sparks become fainter and more numerous. When the rods are separated so that no sparks will pass between them, each will become completely enveloped by a reddish-violet glow light, while numerous fine streamers pass into the surrounding air. If the rods are adjusted to form a narrower gap at the bottom than at the top, the so-called "Jacob's Ladder" effect can be produced. The discharge starts across the narrow gap at the bottom, climbs to the top, ceases, and then



No. 3100E.

automatically starts another climb from the bottom again. This climbing action is due to the fact that the spark produces and follows an ionized gas track that is carried upward by the convection currents resulting from the heat liberated by the spark. In the dark, the spark has the appearance of climbing an invisible ladder. The effect is extremely interesting and very striking.

Figures in Glow. No. 3120E or No. 3122E Figure Plate is mounted on one of the No. 3105E Stands. One Tesla secondary terminal is connected to the hook of the stand, the other to the binding post of the Figure Plate. In the dark, under the Tesla discharge, the outlines of the figures are revealed in a sheath of soft bluish glow light, producing a most beautiful and pleasing effect.

Lighting Lamp by Current Induced in a Two-Turn Coil. The secondary coil, which is the long slender coil within the larger primary coil, is removed. This is done by merely pulling it out of its slip socket. The primary coil is now approached by the No. 3125E Two-Turn Coil with lamp, the latter being an ordinary 6-volt incandescent bulb, and if the Tesla Coil is excited as usual, the lamp will glow, its luminosity depending upon its position in the field about the primary coil. In this experiment the Two-Turn Coil functions as a secondary with respect to the Tesla Primary, showing that the current through the Tesla Primary and the field surrounding it are alternating in character. This same alternating field induces the high potential currents in the Tesla Secondary, showing that, basically, the Tesla Coil operates in the same manner as an ordinary A.C. transformer.

Electrodeless Vacuum Tube in a High Potential Field. The terminals of the Tesla coil are connected to the hooks of No. 3105E Insulating Stands on which the No. 3115E Circular Screens are mounted. The stands are shifted so that the screens are parallel and about ten inches apart. The Tesla coil dis-

Tesla Coil—Cont.

charge produces a high potential field in the space between the two screens: And, when No. 3130E Vacuum Tube, which has no electrodes, is placed in this field, it exhibits a soft bluish glow which fills the entire tube. In addition, portions of the glass walls exhibit greenish fluorescence. This demonstration is extremely striking when presented in the dark.

Electrodeless Neon Tube in a High Potential Field. The tube, No. 3135E is 50 cm. long and when brought into the high potential field, formed between the mounted screens as explained in the preceding paragraph, glows with a vivid reddish light which completely fills the tube. By moving it to various points in and about the screens, the extent and varying intensity of the field is revealed, for within certain limits the luminosity of the tube is proportional to the intensity of the field. Further, when the field becomes too weak, the glow ceases entirely. This tube is also valuable for exploring the fields about the input coil, the lead wires, leakage paths along the table top, etc. In the dark, it makes possible a most striking demonstration. Held in one hand by the narrow stem, it is moved back and forth through the field, between the screens, with a swift, even motion. To an observer, the motion of the tube seems to have been arrested every inch or so of its swing, and he sees six or seven images, each displaced by several degrees, instead of just a single image. The fact is the tube alternately lights up and goes out, but the periods of light and dark, follow so rapidly that, due to persistence of vision, this is not noticeable when the tube is still or moves slowly. However, when the tube is moved rapidly, only the positions it occupied when lighted are revealed, hence its apparent jerky motion. We know of no finer, simpler, nor more effective way of demonstrating the intermittent or oscillating character of high potential discharges and fields.

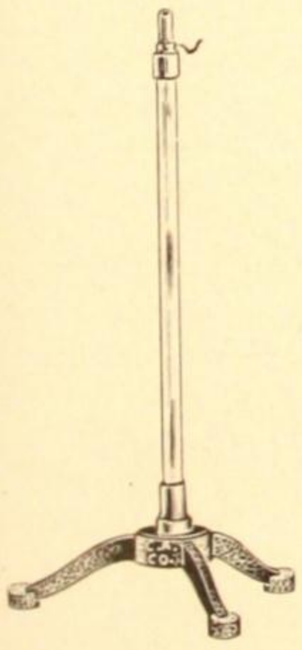
One Electrode Vacuum Tubes. These also fluoresce, phosphoresce and glow when placed in the high potential field described above, even though no connection is made to their single terminal. However, when one secondary terminal of the Tesla Coil is connected to the terminal of the tube, by a wire or chain, it is excited by a brush discharge, and its action varies depending upon whether the discharge is negative or positive. Then too, it also varies from the field excitation mentioned above. The effects are best visualized in the dark.

Two Electrode Vacuum Tubes. Every type of vacuum tube, Geissler, spectrum and special, can be operated in the high potential field already mentioned, without any connection to their electrodes. Likewise, they can also be operated by connections with wire or chain, to either or both of their electrodes. In many cases, there is a marked difference due to the method of excitation. In every case, the results are extremely beautiful, striking and interesting.

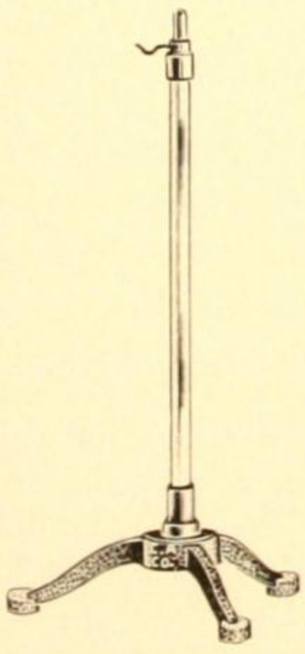
The foregoing experiments are only a few of the many spectacular things that can be done with this Tesla Coil. Variations therefrom and others will readily suggest themselves as the operator becomes familiar with the performance of the coil and the behavior of the accessories mentioned above. The design of the Milvay Tesla Coil is such that all complicated adjustments have been eliminated. It is only necessary to connect it to the secondary of a suitable induction coil or transformer and to vary the Tesla spark-gap to secure fine results. The spark-gap will give some result no matter how large or small it may be, hence the adjustment, which is not critical, to secure the best results, is quickly and easily made. The apparatus is made from selected materials and is finely finished. It stands 50 cm. high overall. As illustrated, but without any of the accessories listed below.....**$75.00**

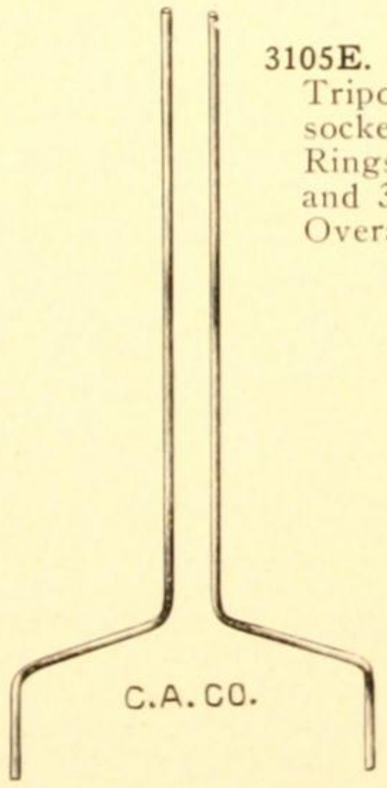
TESLA COIL ACCESSORIES

The striking demonstrations possible with the following accessories is told in detail in the foregoing description of the Milvay Tesla Coil.



No. 3105E.



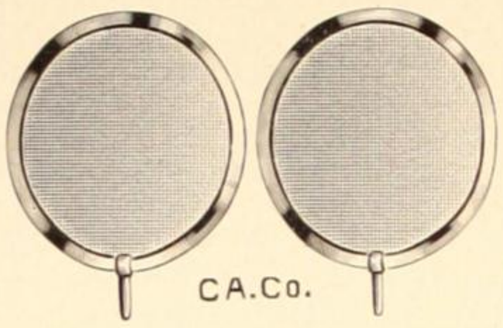


No. 3110E.

3105E. Insulating Stands, High Frequency Type. Tripod base; with glass column carrying a brass socket at its upper end for receiving No. 3110E Rings and Rods, No. 3115E Screens, and Nos. 3120E and 3122E Glow Figures; and hook for connection. Overall height, 40 cm.....**Per pair $8.00**

3110E. Concentric Rings and Rods for Brush Discharge. To fit on No. 3105E Stands. The larger ring is 15 cm. in diameter and the rods are about 42 cm. high. Made from heavy brass rod. Set consists of two rings and two rods ...**Per Set $4.00**

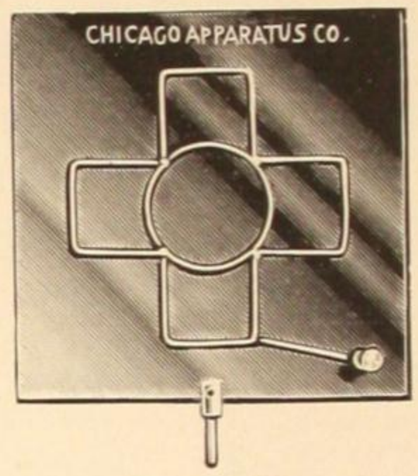
Tesla Coil Accessories—Cont.



No. 3115E.



No. 3120E.



No. 3122E.



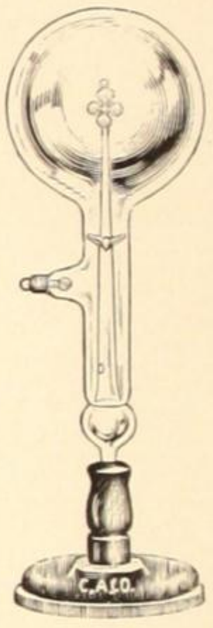
No. 3125E.



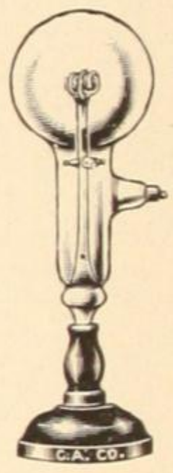
No. 3130E.



No. 3135E.



No. 3140E.



No. 3145E.

3115E. High Potential Field Screens. To fit on No. 3105E Stands. Wire net surface with solid brass ring to provide metallic contact with all wires in the screen. Diameter, about 15 cm. .....**Per Pair $6.50**

3120E. Glow Figure, Star-Shaped. To fit on No. 3105E Stands. On 22x22 cm. heavy hard rubber plate **$7.50**

3122E. Glow Figure, Cross-Shaped. To fit on No. 3105E Stands. On 22x22 cm. heavy hard rubber plate **$7.50**

3125E. Two-Turn Coil with Lamp. Two turns of heavy, insulated wire with socket and lamp for revealing the inductive action of the Tesla primary circuit **$5.00**

3130E. Electrodeless Vacuum Tube. A highly evacuated globe-shaped tube exhibiting glow and fluorescent effects in a high frequency, high potential field. On wooden support. Overall height, 35 cm. **$5.00**

3135E. Electrodeless Neon Tube. A highly evacuated neon tube that glows with a vivid reddish color when brought into a high frequency, high potential field. Size, about 50x3 cm.....**$6.00**

3140E. Vacuum Tube with Phosphorescent Cross. A highly evacuated tube with one electrode and cross, the arms of which are coated with various phosphorescent minerals. When excited by a Tesla discharge, the tube is filled with a bluish glow, portions of the glass exhibit greenish fluorescence, while the cross contributes the several different kinds of colored phosphorescence characteristic of the minerals with which it is coated. The whole presents a most striking effect, which is greatly enhanced in the dark. On wooden support. Overall ht., 39 cm..**$8.50**

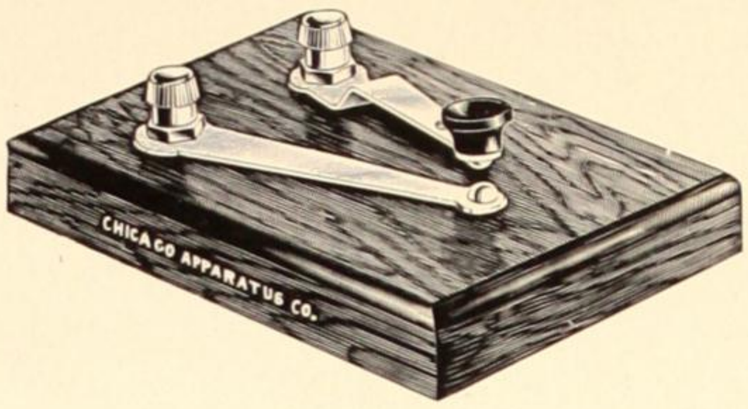
3145E. Vacuum Tube with Phosphorescent Mineral. A highly evacuated tube containing a mineral that exhibits a distinct fiery red phosphorescent glow when excited by a Tesla discharge. It continues to glow for a brief period after the excitation has ceased, showing that it is of the strongly phosphorescent class. During excitation, the tube also fills with a bluish light and portions of the glass exhibit brilliant green fluorescence. The whole effect may be visualized to the best advantage in the dark. On wooden support. Overall height, 25 cm....**$7.50**



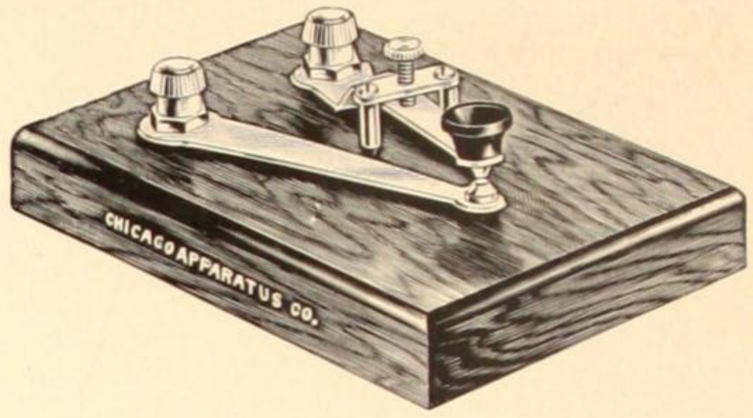
Packing and Shipping

TO reach their destination safely, laboratory instruments and supplies must be packed with the utmost skill and care. This must also be done quickly to insure prompt delivery. Every modern facility that will improve and expedite packing and shipping has been installed in our new plant. Besides, our roomy, day-lighted and well ventilated packing and shipping rooms provide the most ideal working conditions for our skilled and experienced packers. All these things combined, contribute their share toward the prompt and highly efficient delivery service which the Chicago Apparatus Company is rendering to laboratories everywhere.

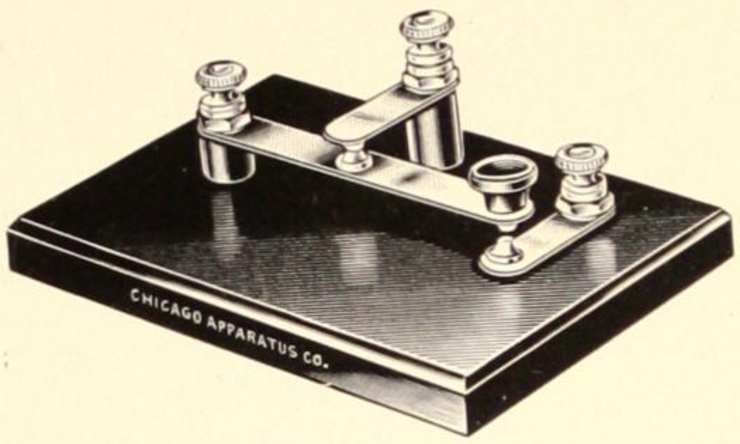
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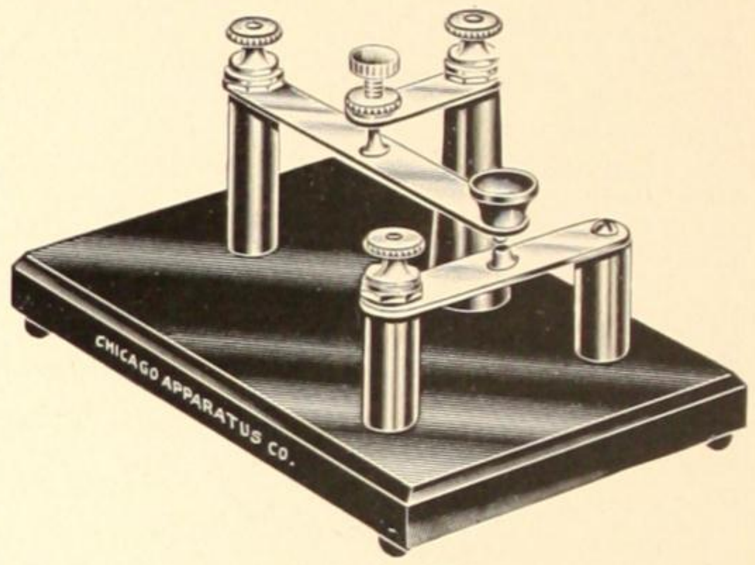
No. 658E.



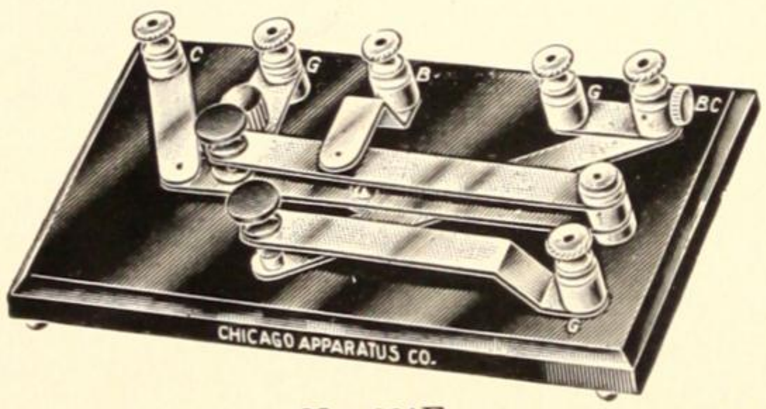
No. 661E.



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No. 663E.



No. 664E.

658E. Key, Single Contact, Milvay. No concealed connections. All metal parts nickel-plated and polished. Nickeled brass contacts. On 10x15 cm. hardwood base **$1.00**

659E. Key, Single Contact, Milvay. Same as No. 658E, but with platinum contacts..... **$2.75**

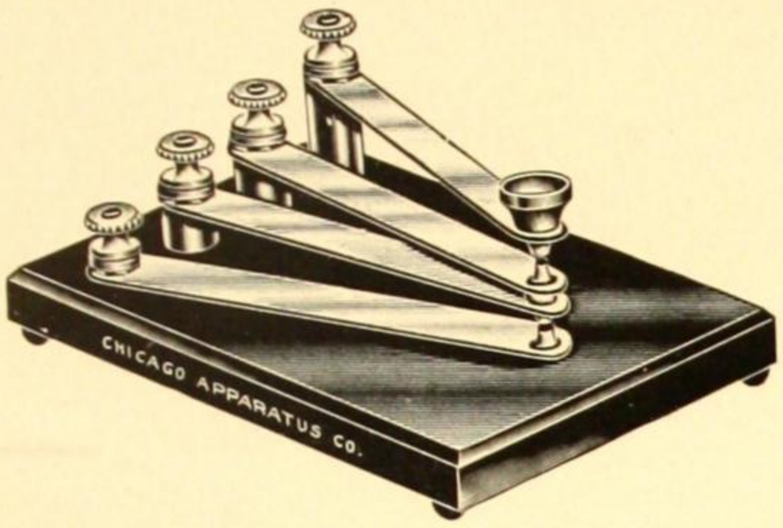
661E. Key, Single, Contact, Lock-Down Type, Milvay. A turn of the screw keeps the circuit closed, a turn in the opposite direction opens it again. May also be used in an ordinary single contact key. All metal parts nickel-plated and polished. Heavy silver contacts. On black-ebony finished 10x15 cm. hardwood base **$2.75**

662E. Key, Single Contact and Short-Circuiting, Milvay. For use in ballistic galvanometer and other measuring circuits for opening one circuit and immediately closing another. Phosphor bronze spring leaf, straight rigid cross-blade, heavy platinum contacts. All metal parts polished and CHROMIUM-PLATED. Design and construction provides high resistance against leakage. On 100x150x13 mm. polished hard rubber base..... **$10.00**

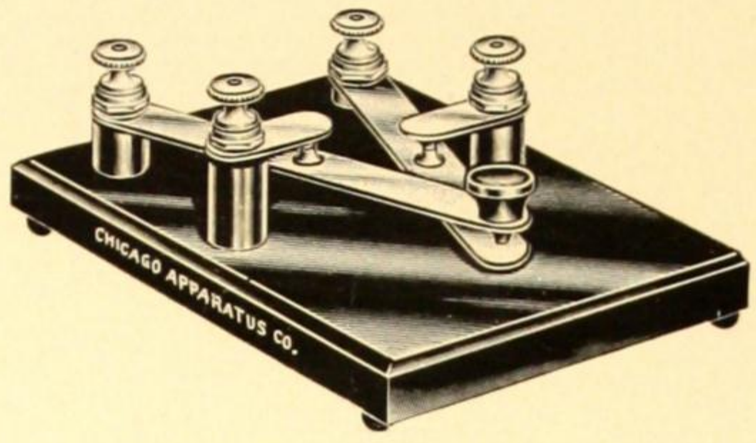
663E. Key, Charge and Discharge, High Insulation Type, Milvay. Especially suited to the needs of circuits employed in the study of condenser capacities and characteristics. All metal parts are mounted upon tall hard rubber pillars to provide additional resistance to leakage. The upper contact is adjustable to permit the reduction of the time interval between the breaking of one circuit and the making of another, to a minimum. The supporting of the heavy strip carrying the lower contact on two pillars, is a new feature which provides greater strength and rigidity. Phosphor bronze spring leaf, extra heavy cross-blade, heavy platinum contacts. All metal parts polished and CHROMIUM-PLATED. On 100x150x13 mm. polished hard rubber base **$16.00**

664E. Key, Discharge and Damping, Zeleny's. After design by Prof. A. Zeleny. This key is so arranged that only the "free charge" of a condenser is discharged through a moving-coil galvanometer, the "absorbed charge" remaining practically undisturbed, resulting in capacity measurements of a higher order of accuracy. It is also useful in obtaining the ballistic constant of a galvanometer on closed circuit by means of a standard condenser. A damping key is located alongside the discharge key. Tapping this key repeatedly will bring the coil of a galvanometer used on open circuit, or not having sufficient damping to be aperiodic, quickly to rest. Phosphor bronze spring leaves, extra heavy cross-blades, large silver contacts. All metal parts polished and CHROMIUM-PLATED. Design and construction provides maximum resistance against leakage. On 110x205x13 mm. polished hard rubber base **$17.50**

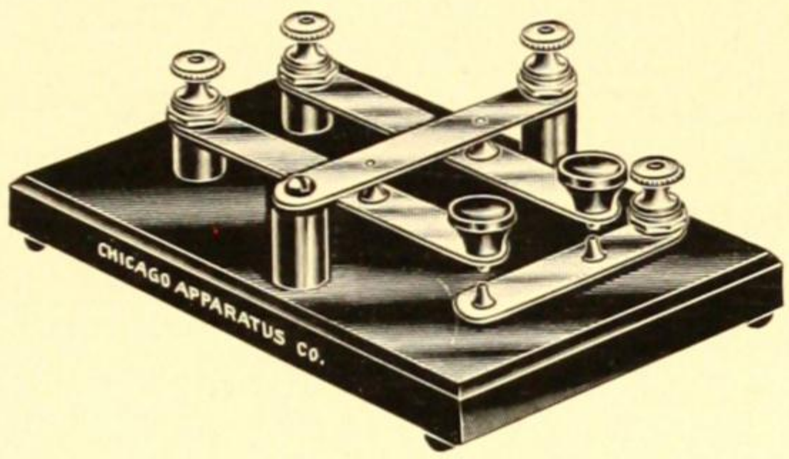
Contact Keys—Cont.



No. 665E.



No. 667E.



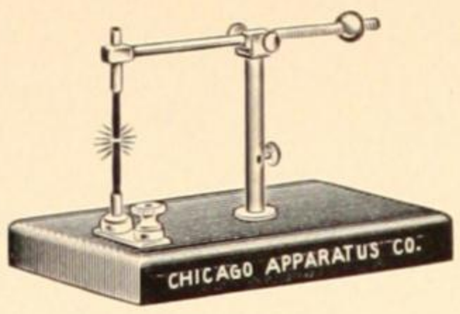
No. 669E.

665E. Key, Double Contact, Milvay. For closing two separate circuits in rapid succession as in Wheatstone Bridge work, where the closing of the battery circuit should be preceded slightly by the closing of the galvanometer circuit. Phosphor bronze spring leaves, hard rubber insulating pillars, heavy silver contacts. All metal parts polished and CHROMIUM-PLATED. On ebony-black hardwood 10x15 cm. base **$10.00**

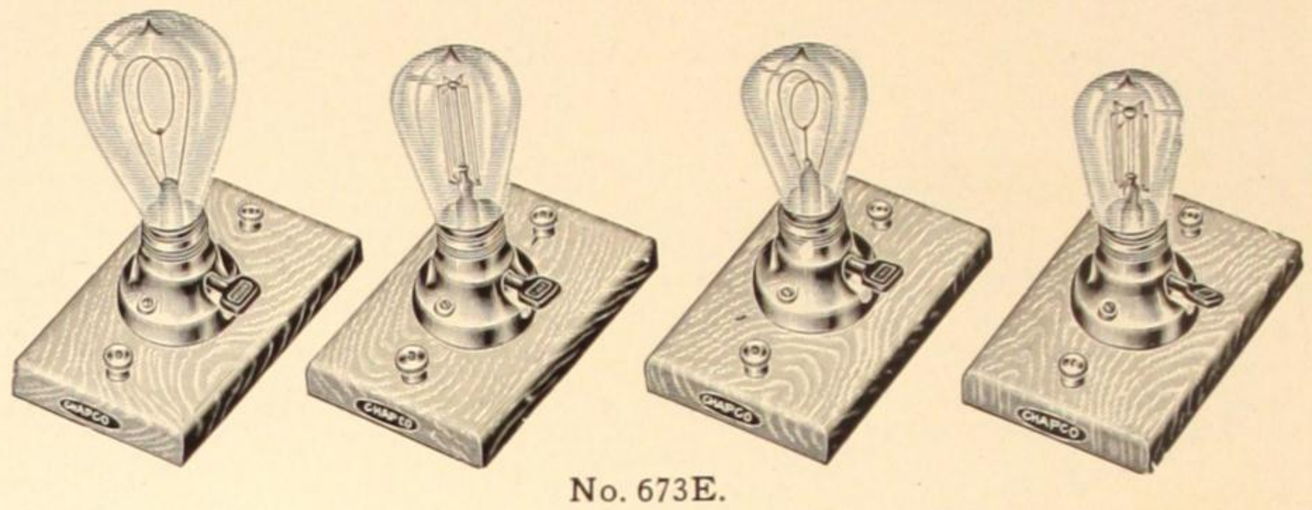
666E. Key, Double Contact, Milvay. Similar to No. 665E, but with heavy contacts of platinum instead of silver, and base of polished hard rubber instead of hardwood; hence more dependable in circuits where high insulation is important. Phosphor bronze spring leaves, hard rubber insulating pillars, heavy platinum contacts. All metal parts polished and CHROMIUM-PLATED. On 100x150x13 mm. polished hard rubber base **$15.00**

667E. Key, Double Break, Milvay. For use in circuits employed in the determination of the quantity of electricity induced in mutual inductance coils, and in the measurement of inductance coefficients by bridge methods. The two pairs of contacts open in quick succession when the key is depressed. Hence, if the key is connected into circuit so that the pair which open last are in series with the ballistic galvanometer, the galvanometer circuit will be opened immediately after the inductive discharge has taken place. The coil, having barely started to move when the circuit shunting is opened, is enabled to make practically its entire swing undamped. The result is larger and more dependable galvanometer deflections and obviously a higher order of accuracy in the above-mentioned class of measurements. Phosphor-bronze spring leaves, extra heavy cross-blades, large silver contacts. All metal parts polished and CHROMIUM-PLATED. On 100x150x13 mm. polished hard rubber base..... **$15.00**

669E. Key, Commutating or Reversing, Milvay. For sending the current from a battery or other source in either direction through a piece of apparatus. Also, for repeatedly and rapidly reversing the direction of current flow through a circuit. No current will flow when both keys are up. When the key to the left is down the current flow through the apparatus is in one direction, and when the other key is down it is in the reverse direction. Also, the arrangement of this key is such that it can readily be connected into circuits to serve as a single contact key, two-circuit "make" key, break key, or damping key. Obviously its range of usefulness and convenience makes it ideal for lecture purposes. Phosphor-bronze spring leaves, extra heavy cross-blades, large silver contact. Upper cross-blade is supported on two pillars, providing maximum rigidity. All metal parts polished and CHROMIUM-PLATED. On 100x150x13 mm. polished hard rubber base **$17.50**



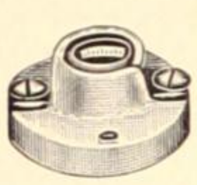
No. 668E.



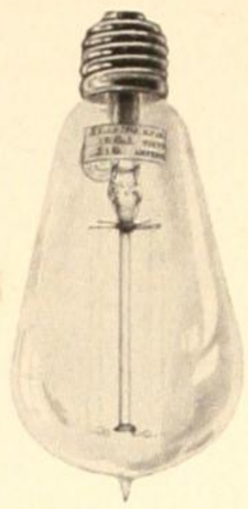
No. 673E.



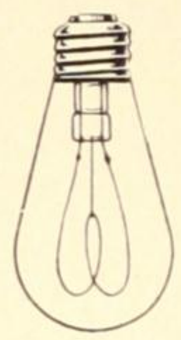
No. 678E.



No. 683E.



No. 420K.



No. 415K.



No. 423K.

No. 685E.



No. 686E.

668E. Lamp, Arc. With counterpoise adjustment. May be operated by No. 398E Hand Power Dynamo or a plunge battery. On hardwood base, 10x15 cm. Complete with carbons.....**$6.00**

673E. Lamps, Incandescent. As used in Millikan, Gale and Bishop's Course in laboratory work on lamp efficiency.

Set contains one each 20 and 40 watt tungsten filament lamps and one each 55 and 120 watt carbon filament lamps, all for use on 110 volt A.C. or D.C. circuit. Each lamp is mounted separately on a 10x15 cm. wood base with key socket and binding posts. This enables them to be connected either in series or parallel. A splendid combination for studying: (1) The advantages of series and parallel connections, (2) the comparative efficiency of tungsten and carbon filament lamps.

Per set of four, complete as illustrated.....**$8.00**

678E. Lamps, Incandescent, Miniature. Tungsten filament, threaded to fit No. 683E Receptacle.

Cat. No.	678E	679E	680E
Candle power	1	1½	4
Voltage	2½	3½	6
Each	**$0.20**	**.30**	**.50**

683E. Lamp Receptacle. Porcelain, for No. 678E Lamps.....**$0.25**

415K. Lamps, Incandescent. Carbon Filament. Edison base, fit all Edison receptacles and sockets.

No.	0	1	2
Voltage	110	110	110
Candle power	8	16	32
Each	**$0.30**	**.30**	**.40**

416K. Lamps, Incandescent. Tungsten Filament. Edison base, fit all Edison receptacles and sockets.

No.	1	2
Voltage	6	8
Candle power	4	6
Each	**$0.65**	**.65**

417K. Lamps, Incandescent. Tungsten Filament. Edison base, fit all Edison receptacles and sockets.

No.	0	1	2	2A	3	4
Voltage	110	110	110	110	110	110
Candle power	12	30	50	75	95	125
Watts	10	25	40	60	75	100
Each	**$0.35**	**.35**	**.35**	**.60**	**.70**	**.75**

418K. Lamps, Incandescent. Tungsten Filament. Edison base, fit all Edison receptacles and sockets.

No.	1	2	3	4	5	6
Voltage	12	24	32	55	65	80
Candle power	12	30	30	30	50	50
Watts	10	25	25	25	40	40
Each	**$0.50**	**.50**	**.50**	**.50**	**.50**	**.50**

419K. Lamp, Standard Incandescent, Carbon Filament. A selected 110-volt, 16 C.P., 64 Watt carbon filament lamp standardized for stationary use and furnished with certificate of candle power from a Recognized Testing Laboratory. Accuracy of rating. ¼%.....**$5.25**

420K. Lamps, Standard Incandescent. Mazda tungsten filament lamps of special construction carefully selected, aged, standardized and certified.

More satisfactory as light standards than carbon filament lamps. Each lamp is accompanied by a standardization certificate from the Photometric Testing Laboratory with the number corresponding to that of the lamp, upon which is recorded all of the data pertaining to the lamp—volts, amperes, horizontal candle power, watts per candle, etc. The accuracy maintained is .3 per cent or better. In ordering specify the voltage at which the lamp should be standardized (anywhere between 100 and 130 volts) and the watt-size desired. For stationary use.

Watts	25	40	50
Each	**$12.00**	**12.00**	**12.00**

423K. Lamp, Neon Glow. This new lamp creates a distinctive light through the medium of luminous neon gas.

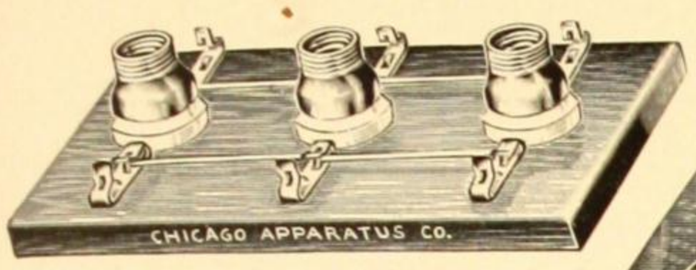
Has no filament to burn out. Designed for normal operation on 110 volt A.C. and at that voltage consumes but ½ Watt. Will also operate on D.C. above 150 volts, but when so operated only one electrode will glow. Useful as indicator lamp to show that current is on, as signal lamp in test circuits, as a readily modulated light source, as a stroboscopic illuminant because of the rapidity with which it can be lighted and extinguished, as a source of light for obtaining line spectra, as a test lamp for indicating whether current flowing through a circuit is A.C. or D.C., etc.

Fits the ordinary Edison screw socket.....**$0.65**

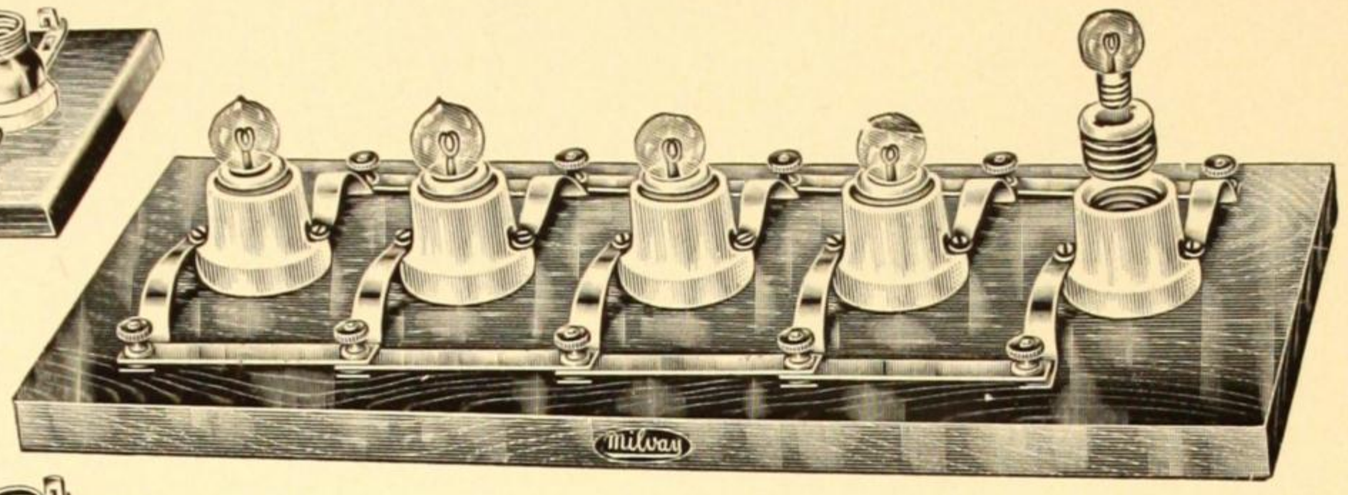
685E. Lamp, Pocket Flash. Fiber case, nickel-plated trimmings, Tungsten bulb and battery. Size 1⅝x6⅝ inches.....**$1.40**

686E. Battery for No. 685E, for replacement.... **.35**

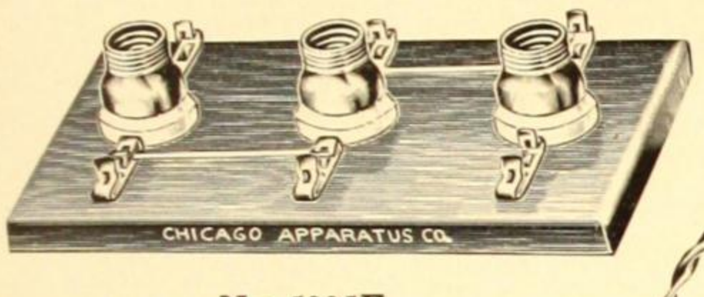
687E. Tungsten Bulb, for No. 685E, for replacement.....**$0.25**



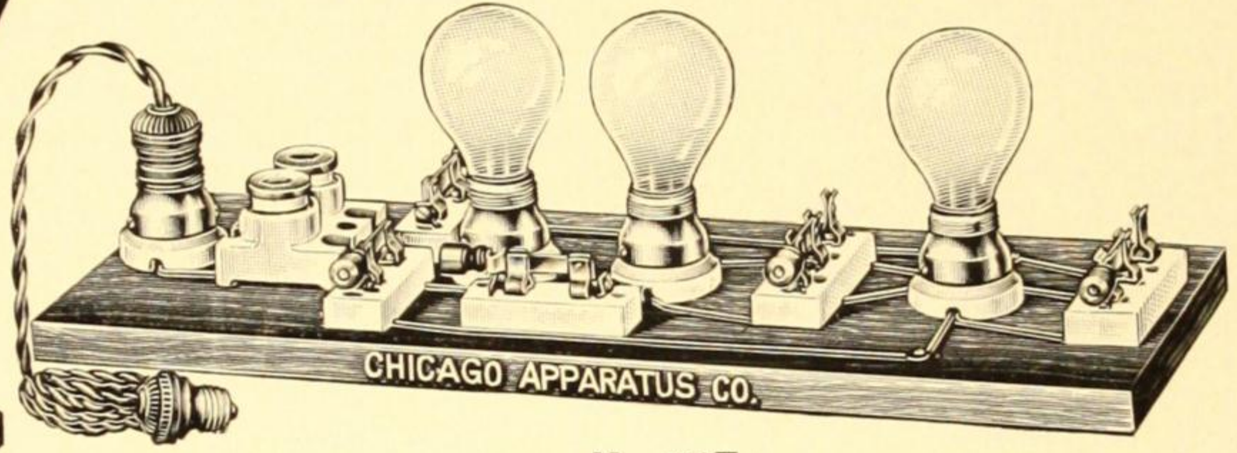
No. 5000E.



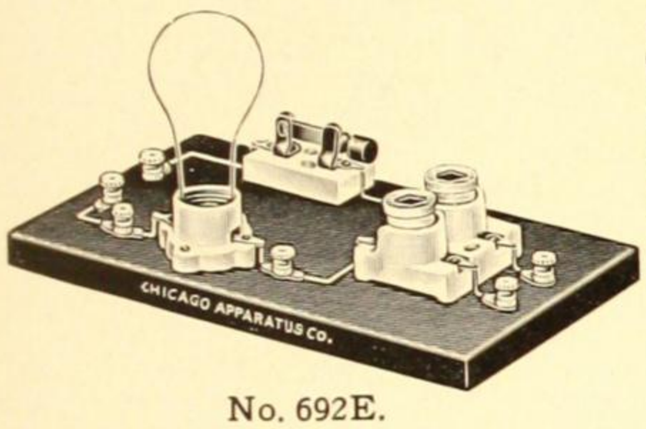
No. 688E.



No. 5005E.



No. 691E.



No. 692E.

5000E. Lamp Board, Parallel Circuit. For use in studying the current and resistance relations in parallel lamp circuits by the voltmeter-ammeter method as outlined in Exp. 66 of Fuller, Brownlee and Baker's "Laboratory Exercises in Physics." The three standard Edison lamp sockets are mounted on a finely finished 17.5x30 cm. hardwood base, and the terminals of each socket are provided with double Fahnestock connectors. This makes it most convenient to connect either one, two or three lamps into circuit. Likewise, it also makes it very convenient to introduce the meters employed for making the current and voltage observations. Without lamps **$4.50**

5005E. Lamp Board, Series Circuit. Same as No. 5000E, but with sockets connected for series circuit tests. Without lamps..... **$4.50**

688E. Lamp System, Milvay. Five Edison sockets mounted on a finely finished hardwood base. May be easily connected in series or in parallel. All connections are visible. Useful in experiments with Hand Power Dynamos and as a power distributing board. In the latter case one socket is connected to a lighting socket or other current source, by means of a cord and plug. The other four sockets then become outlets for distributing current to lamps, motors and other devices used in laboratory work. Used in this way it is especially convenient in lecture table work. Without lamps..... **$5.00**

689E. Lamps, Set of Five. Six-volt, for No. 688E. These low voltage lamps are desirable when using No. 688E in connection with Hand Power Dynamos **$3.00**

691E. Lamp System, Circuit Analysis, Fountain's.

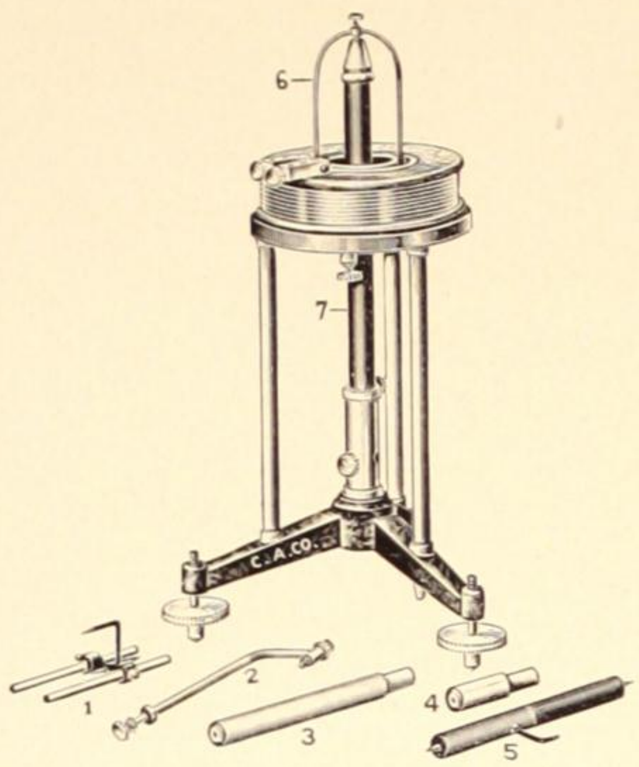
This board, designed by Dr. C. R. Fountain, Peabody College for Teachers, Nashville, Tennessee, is intended primarily to give the student practice in tracing out electric circuits, so that he may become better fitted to connect up apparatus with some assurance that he can get the current to go where he wants it and in the proper quantity to safeguard injuries to delicate instruments. It is "FOOLPROOF." A detachable lamp cord is supplied so that the board may be connected directly to the regular lighting circuit by simply plugging into any lamp socket. The switches are so arranged that it is impossible to get a short-circuit by any combination of them. FOURTEEN COMBINATIONS are possible.

The board contains three S.P.S.T. switches, two S.P.D.T. switches and three lamp sockets. Without changing the positions of the single set of three lamps installed therein fourteen different resistances and fourteen different current values may be obtained by simply using different combinations of the switches.

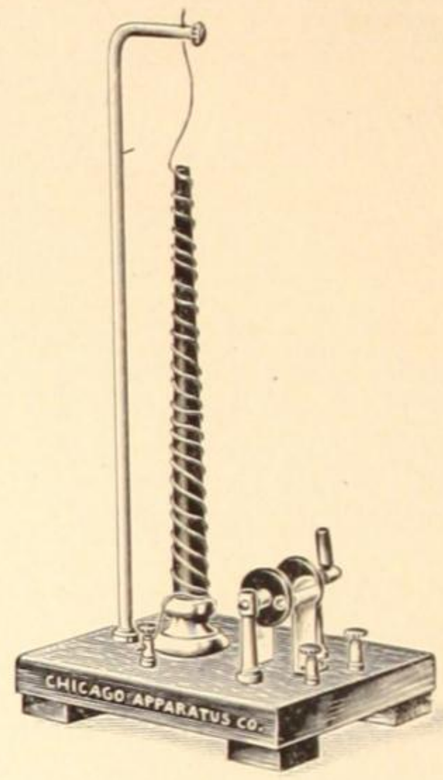
Assuming that the resistances of the lamps do not change with variations in the current through them, the total resistance of the board may be calculated very easily when the three lamps are just alike. When the lamps are all different in size, these calculations for the fourteen different cases are a bit more complicated. Since the resistances of all kinds of lamps do change with the current through them, it is of considerable value to bring out this point by the Ammeter-Voltmeter Method, which can be readily employed with this board.

Complete as illustrated, including three 60-watt, 110-volt lamps and full directions..... **$12.50**

692E. Lamp Test Board, Dull's. For use in measuring the hot resistance of standard Edison base incandescent lamps, such as 110-volt-32 c.p. carbon, 110-volt-40 watt tungsten types and others, by the voltmeter-ammeter method as outlined in Exp. 63 of Dull's "Laboratory Exercises in Physics." Consists of one socket, two fuse blocks with six ampere fuses, knife switch for opening and closing the circuit, and binding posts mounted and wired upon a 20x30 cm. finely finished board, as illustrated. The use of this board provides simplicity of operation and insures the connection of the meters at the proper points in the circuit **$4.00**



No. 2427E.



No. 2428E.

2427E. Lines of Force Apparatus, Milvay Universal Type. For showing that the interaction between the field surrounding a current carrying conductor and a magnet is such that if one is fixed, motion is imparted to the other. Also, that under similar conditions, the same interaction occurs between the fields of two current carrying conductors. Hence, the use of this apparatus leads to a fuller and better understanding of the principles that underly the action of galvanometers, ammeters, voltmeters, motors, dynamos and other devices in which interactions between magnetic fields occur.

The apparatus is designed for operation on any low voltage D.C. current. The terminals for leading the current through the fixed and movable conductors are conveniently located, one just above figure 7, the other directly below it in the socket at the center of the base. The coil, a separate unit to be removed when not in use, is provided with independent terminals. The four most important demonstrations possible with this instrument are:

Rotation of a Movable Current about a Fixed Magnet. Magnet No. 7 and Conductor No. 6 are arranged as in the illustration, the ends of the conductor dipping in mercury in the circular trough. When a current is caused to flow through the conductor, the latter rotates about the magnet.

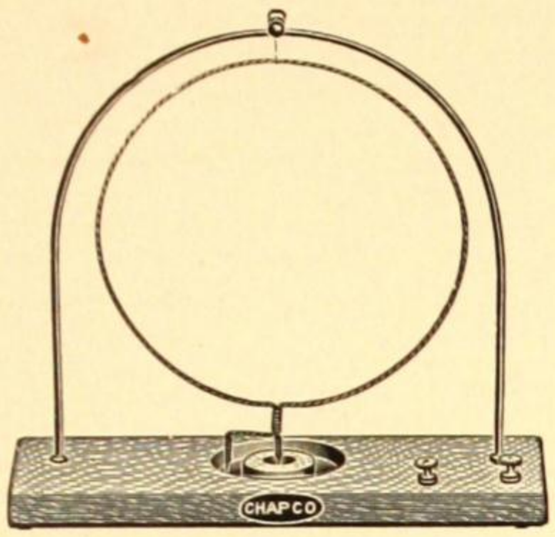
Rotation of a Movable Magnet about a Fixed Current. Magnet No. 1 is suspended and pivoted between Pillar No. 3 and Holder No. 2, in the central vertical axis, with its contact arm touching the mercury in the circular trough. When a current is caused to flow through the Pillar, the magnet rotates about former.

Rotation of a Movable Magnet about its Own Axis Under the Influence of a Current. Magnet No. 5 is pivoted between Pillar No. 4 and Holder No. 2, in the central vertical axis, with its contact arm touching the mercury in the circular trough. When a current is caused to flow through the magnet, the latter rotates about its own axis.

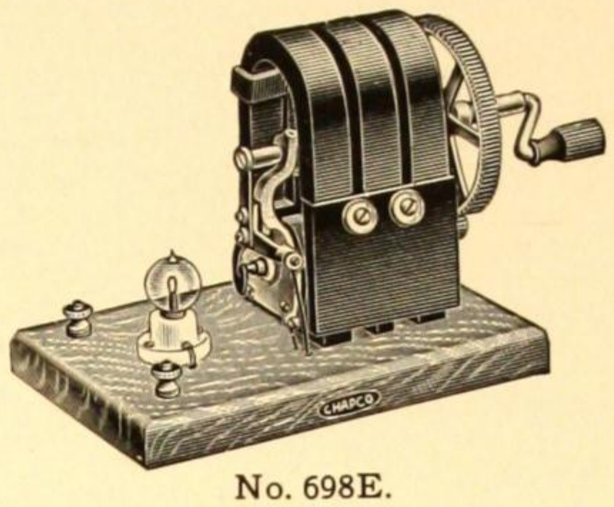
Rotation of a Movable Current about a Fixed Current. Conductor No. 6 is pivoted on Pillar No. 7, with its ends dipping in mercury in the circular trough. The coil is placed in position as in the illustration. When a current is sent through the coil and another through the Conductor, the latter rotates about the Pillar.

In all of the foregoing experiments it can be shown that when only the direction of current flow, or only the polarity of the magnet is reversed, rotation is likewise reversed. Further, that when both the direction of current flow and polarity are reversed, the direction of rotation remains the same. The apparatus is well built and finely finished. Overall height, 35 cm. With accessories as illustrated **$35.00**

2428E. Lines of Force Apparatus, Milvay Flexible Conductor Type. For illustrating the interaction between the field surrounding a fixed magnet and a flexible conductor. Three to four turns of the flexible conductor are wound about the tall fixed magnet. When a current (about 4 volts D.C.) is caused to flow through the conductor, it unwinds and rewinds in the opposite direction. When the current flow is reversed, the unwinding and rewinding are likewise reversed. Well built, and finely finished, with convenient commutator in circuit on the base. Overall height, 37.5 cm. With extra length of flexible conductor **$10.00**



No. 693E.



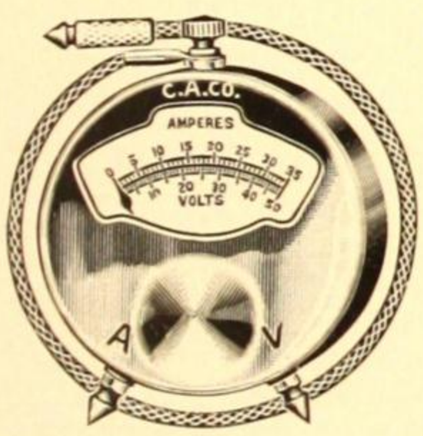
No. 698E.

693E. Magnetic Loop. For demonstrating that a wire loop, through which a current is flowing, behaves like a magnetized disc with poles located on opposite faces. Consists of a wire loop, 8 inches in diameter, adjustably suspended by a thread so that its two ends dip into mercury (a liquid conductor) contained in a special mercury cup having a central cavity and an annular groove. One binding post is connected with the central cavity, the other with the annular ring. A current of electricity sent into one binding post must pass through the wire loop before it can escape from the other. With a current flowing through it, the loop turns until its plane is at right angles to the lines of force of the earth's magnetic field, a position in which it incloses the largest possible number of the earth's line of force.....**$5.00**

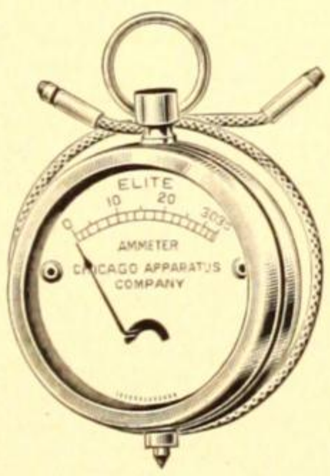
698E. Magneto Electric Generator. Four-bar type (illustration shows three-bar type) on 15x25 cm. base with binding posts and incandescent lamp. The current generated will light the lamp and also produce a strong physiological effect, which may be noted by touching the binding posts after the lamp has been thrown out of circuit.....**$7.50**

699E. Extra Lamp. For No. 698E, for replacement **$0.50**

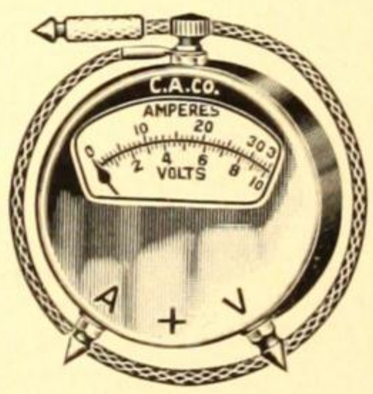
Battery Meters, Pocket Type



No. 711E.



No. 713E.



No. 715E.

Accurate, reliable and dead beat. Will register regardless of polarity. Diameter, 50 mm. by 13 mm. thick. Nickel-plated case with beveled glass front. The correct reading is shown almost the instant contact is made, which means saving of time and reduction to a minimum of battery consumption while testing. Each instrument is guaranteed against mechanical defects, and to register correctly. Flexible conducting cords with tips furnished with each instrument. The combination volt-ammeter will register both volts and amperes. The left hand bottom contact for volts and the right hand bottom contact for amperes.

711E. Voltammeter, range 0 to 50 volts and 0 to 35 amperes. For testing amperage of dry cells and voltage of "B" batteries—storage or dry type....**$3.50**

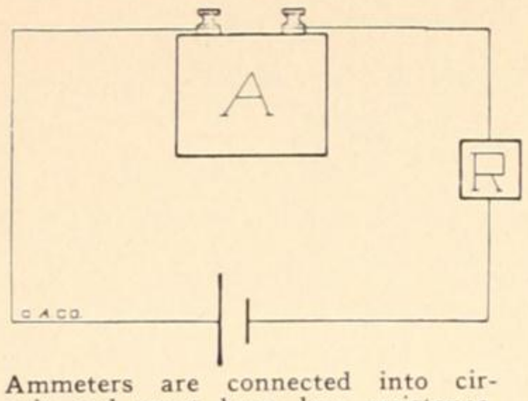
712E. Voltmeter, Double Scale. Ranges 0 to 8 in ¼-volt and 0 to 150 in 5-volt divisions. Low range for testing dry or storage "A" batteries, high range for testing dry "B" batteries with a total voltage as high as 150 volts. Not suitable for testing storage "B" batteries with a total voltage in excess of 96 volts **$4.00**

713E. Ammeter, range 0 to 35 amperes..... **.90**

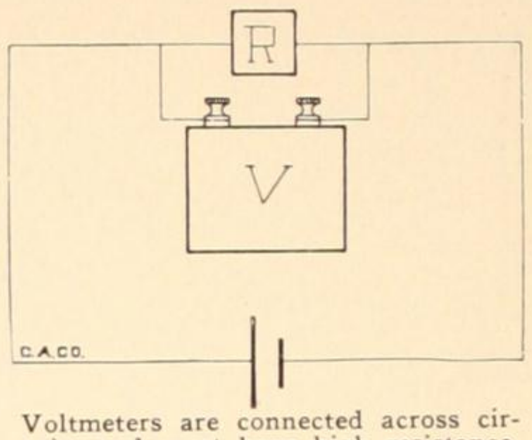
714E. Voltmeter, range 0 to 10 volts..... **1.10**

715E. Voltammeter, range 0 to 10 volts and 0 to 35 amperes **$1.25**

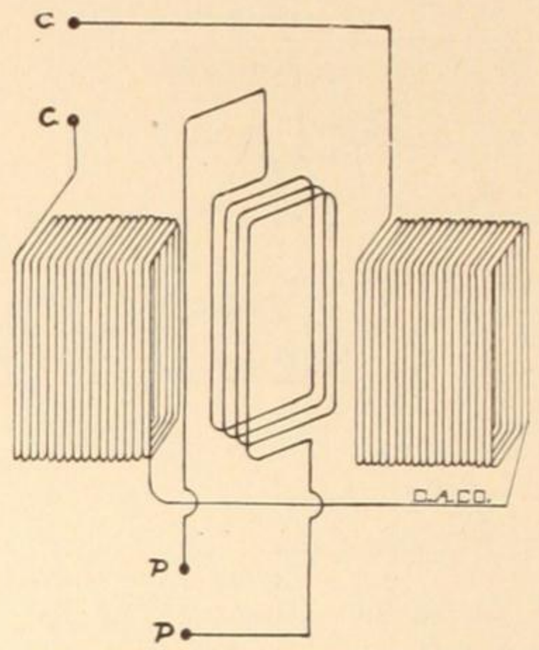
Useful Information About Electrical Meters



Ammeters are connected into circuit and must have low resistance.



Voltmeters are connected across circuits and must have high resistance.



Wattmeters are connected into and across circuits and must have both low and high resistances.

Ammeters

Ammeters intended for laboratory use should be of the low resistance type. There is a good reason for this. In most experimental work low voltage and low resistance circuits are employed. The resistance of an ammeter determines the minimum voltage and the minimum resistance of the circuit in which it will yield results of acceptable accuracy—within 1%. Consideration of typical instruments and typical circuits and the application of Ohm's Law will bear this out. Taking a circuit in which the resistance is 0.8 ohms and the e.m.f. 8 volts, it is obvious that the current flow is 8÷0.8 or 10 amperes. Supposing that an ammeter, which is considered a good instrument by authorities on electrical measurements, i.e., one having a resistance (in the 10 ampere range) of .0075 ohms, is connected into this circuit, it is obvious that the total resistance of the circuit is raised to 0.8075 ohms and the current flow reduced to 8÷0.8075 or 9.91 amperes. The indication on the meter will, therefore, be low by nearly 1%. Supposing, however, an ammeter with a resistance of .045 ohms—and this is typical of many instruments having large magnets, cores, coils, gaps, and springs—is used, the circuit resistance would be raised to 0.845 ohms and the current flow reduced to 8÷0.845 or 9.47 amperes. Consequently, the meter reading would be 5% too low. Even in a circuit of 50 volts and 5 ohms, its indications will be nearly 1% off—50÷5.045 or 9.91 amperes, while the indications on the first instrument would be correct to 1/5%—50÷5.075 or 9.98 amperes. Obviously, then, ammeters to be satisfactory for laboratory service must have extremely low resistances. In the 10 ampere range it should not exceed .0075 ohms with resistances inversely proportional in other ranges. Since any resistance, no matter how slight, raises the total resistance of the circuit and reduces the current flow therein, it is obvious that connections to ammeters should be as low in resistance as possible and the contacts as good as possible. Only under such conditions can good ammeters give correct indications.

Voltmeters

Voltmeters intended for laboratory use should be of the high resistance type. The importance of this cannot be over-emphasized. By far, most laboratory work is with low power circuits. On such circuits high resistance voltmeters give indications within the limits of allowable error—about 1%. Authorities on electrical measurements are agreed that voltmeters with resistances of about 100 ohms per volt are good instruments. In the ten volt range, such an instrument has a total resistance of 1000 ohms, and for a full scale deflection draws a current of 10÷1000 or 10 milliamperes. Obviously, if such an instrument is connected across a circuit carrying as little as 1 ampere (1000 M.A.); it would indicate correctly within 1%. If in a similar case a voltmeter having a resistance of only 200 ohms were employed—and such low resistances are usually found in meters with large magnets, cores, coils, gaps, and springs—the indication would be 5% too low, because of the greater current draw—50 M.A. To indicate within 1% of the true voltage it would have to be connected across a circuit carrying at least 5 amperes. On the same circuit readings on the high resistance type would be accurate to 1/5%. Obviously, then, voltmeters to be satisfactory for laboratory service should have a very high resistance—about 100 ohms per volt. Bearing in mind that even a good voltmeter draws a current of about 10 M.A., it is easy to understand why even such a fine instrument cannot give correct readings on Radio, "B" Battery and "B" Power Supply circuits. The currents in such circuits are always very small—10 to 80 M.A. Assuming the current flow in such a circuit to be 20 M.A., and the actual e.m.f. 100 volts, the indication on a good voltmeter, such as described above, would be only 50 volts—but one-half the true voltage. To secure close readings in such cases, special high resistance voltmeters having the remarkably low current draw of but 1 M.A. are now available. Such instruments are listed on succeeding pages under Nos. 2565E, 2685E, 2690E, 2695E. In the case mentioned above, such instruments will give good readings on circuits carrying as little as 10 M.A. In addition to radio work, they are well adapted for voltage measurements in low amperage circuits such as are encountered in work with photometric cells, television experiments, etc. Good connections should be established to voltmeters but because of their high resistance, leads of higher resistance than employed in ammeter connections will not introduce the same appreciable errors.

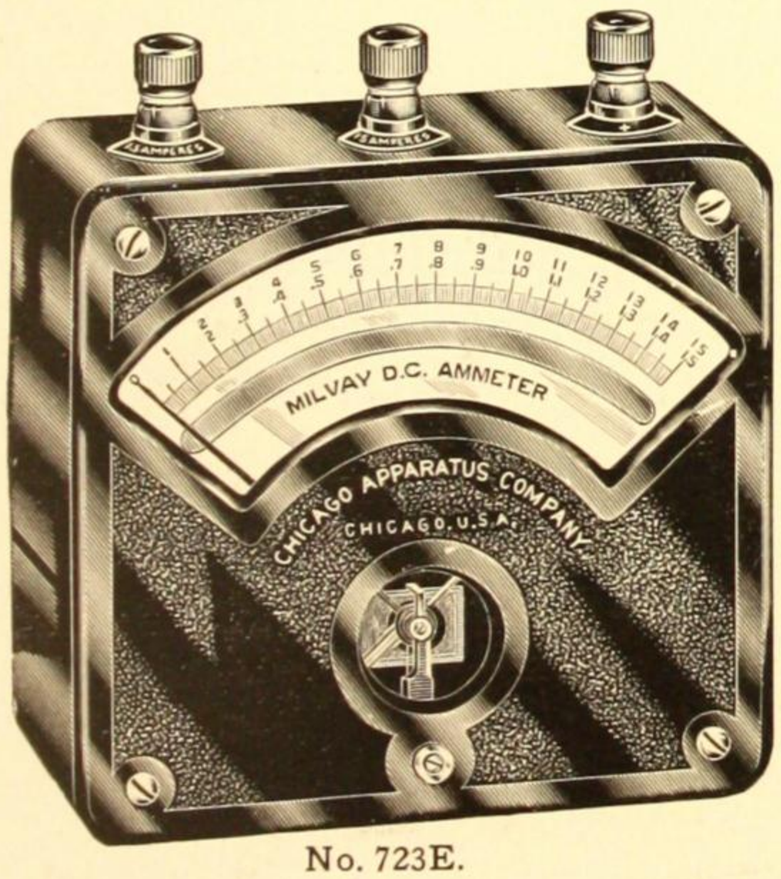
Wattmeters

These instruments measure power directly in terms of watts. A fixed current coil of low resistance replaces the familiar permanent magnet found in other meters. The potential coil is a high-resistance, pivot-mounted coil similar to the moving coil in voltmeters. Both coils have independent external binding post

terminals. The current coil, like an ammeter, is connected into circuit and the potential coil, like a voltmeter, is connected across the line. The magnetic interaction between the fields of the two coils causes the pointer to swing over the scale. Since deflections are the resultants of both current and voltage (power), the scales are calibrated to read direct in watts. Obviously, wattmeters cannot indicate correctly when the maximum ratings of either or both coils are exceeded even though the wattage of the device under test falls within the scale range. Therefore, in selecting a wattmeter, the one having maximum coil ratings in excess of the maximum current consumption and maximum operating voltage of devices to be tested, should be specified. Good wattmeters like good ammeters and voltmeters must have low-resistance current coils and high-resistance potential coils to fit them for experimental laboratory work.

Jewell Meters Are Good Laboratory Meters

Jewell meters possess good resistance characteristics, as will be noted from the detailed specifications given on succeeding pages. Anyone familiar with good electrical measuring instruments knows that meters possessing such fine electrical characteristics must likewise possess fine merchanical characteristics. They must be built like a watch. They must have jewelled bearings, delicate control springs, small light coils, small cores, small gaps, powerful magnets, and cases sealed against dirt and moisture. Their appearance must be in keeping with the excellence of their construction and performance in order to gain and maintain the respect of users. Jewell meters possess these qualifications and that is why they are rapidly becoming the standard for laboratory use.



No. 723E.

Jewell-Milvay D.C. Meters

The Jewell-Milvay meters described on this page and listed on page 92 are recommended as the type most suitable for student and general laboratory use. Milvay engineers with two decades of experience in equipping educational laboratories with meters, working in conjunction with Jewell technicians, designed this economical meter, having advantages found in no other instrument in its price class.

A standard Jewell D'Arsonval movement is incorporated in a finely finished rectangular Bakelite case of special Milvay design. Since the case is rectangular and the movement is correctly balanced, the meter can be used in either a vertical or horizontal position. The fact that the meter can also be used in a vertical position is a decided advantage, as the instrument can be easily read at a table by the experimenter without rising. Where a number of instruments are being used on a good sized table and the meters must of necessity be away from the equipment used directly in front of the worker, a meter that cannot be used vertically is unsuitable.

This important feature distinguishes the Jewell-Milvay line of instruments from those of other manufacturers whose meters of comparative price have movements mounted on a flat base with a raised case.

Another advantage lies in the fact that the scale of the Jewell-Milvay meter is considerably larger than that ordinarily employed—making the instrument easier to read accurately. The vertical feature and the larger scale permit this meter to be used in classroom demonstration—a distinct advantage.

Above all, the greatest advantage of Jewell-Milvay Meters lies in their fine electrical characteristics. Experience during the past decade in college and engineering laboratories has conclusively established that voltmeters with certain high resistances and ammeters with certain low resistances yield results accurate to the small fractional percentages allowable in electrical measurements involving the low voltage and low resistance circuits employed in experimental work. The resistance characteristics of Jewell-Milvay meters conform to these now well-recognized and well-established standards. This added refinement is an all-important one as it positively assures results of acceptable accuracy in all laboratory experimental work. Furthermore, this feature also adapts Jewell-Milvay Meters to constant duty service, making it possible to leave them in circuit indefinitely without the slightest danger of any ill effects to their delicate movements.

With the fine electrical characteristics just mentioned, improved Bakelite case, sensitive watch-like precision-type Jewell Movement, there is no better meter buy for the educational laboratory.

Specifications

Guaranteed accuracy—1 per cent.

Voltmeter resistance—More than 100 ohms per volt or more than a total of 960 ohms for a 12-volt range instrument.

Ammeter resistance—Approximately 0.006 ohms for a 12-ampere range instrument with correspondingly lower resistances for higher ranges.

Scale—4¼ inches long, giving large, easily read divisions.

Cases—Bakelite, rectangular shape, 5⅜x5⅜x2¼ inches deep. Sealed air-tight to exclude dust and moisture, preventing deterioration of the internal mechanism.

Zero adjuster—Improved external control type.

Pointer—Knife-edge type over anti-parallax mirror.

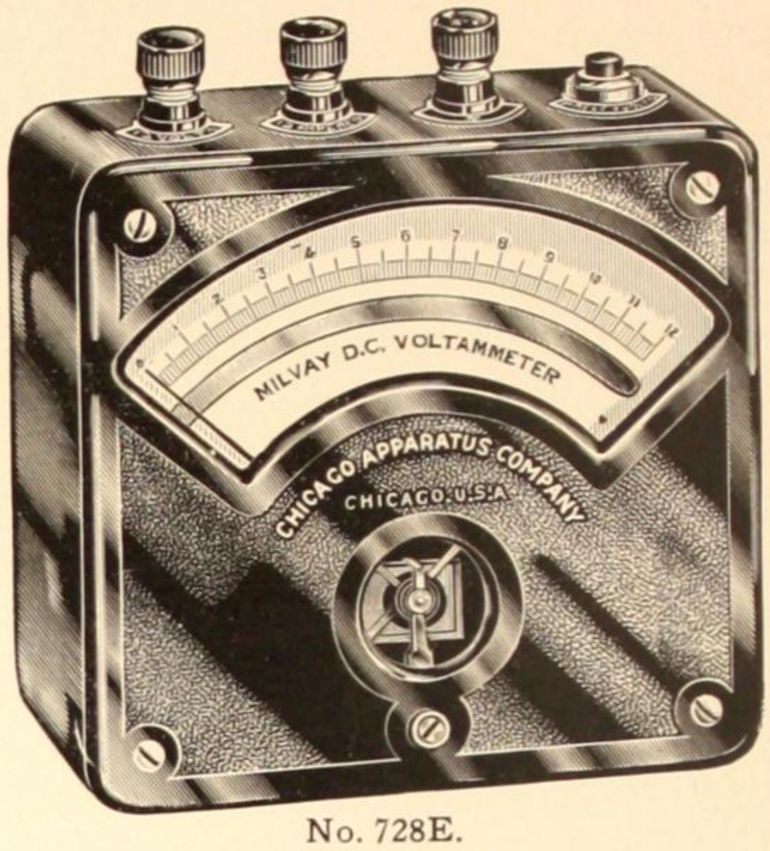
Movement—Jewell D'Arsonval precision watch-like type.

Ranges—See listing on page 92.

Jewell-Milvay Direct Current Meters—Cont'd



No. 727E.



No. 728E.

RANGES

This group comprises a line of single and double range ammeters and voltmeters, as well as one volt-ammeter, in ranges admirably adapted for making the D.C. current and voltage measurements required in students' experiments, lecture demonstrations, and general work in high school and college laboratories.

721E. Jewell-Milvay Ammeters, Single Range—

No.	A	B	C
Range, zero to, amperes	3	15	30
Value of smallest division, amperes	1/20	1/10	1/5
Each	**$17.50**	**17.50**	**17.50**

723E. Jewell-Milvay Ammeters, Double Range—

No.		B	C
Range, zero to, amperes		1.5 & 15	3 & 30
Value of smallest division, amperes		1/100 & 1/10	1/50 & 1/5
Each		**$20.00**	**20.00**

725E. Jewell-Milvay Voltmeters, Single Range—

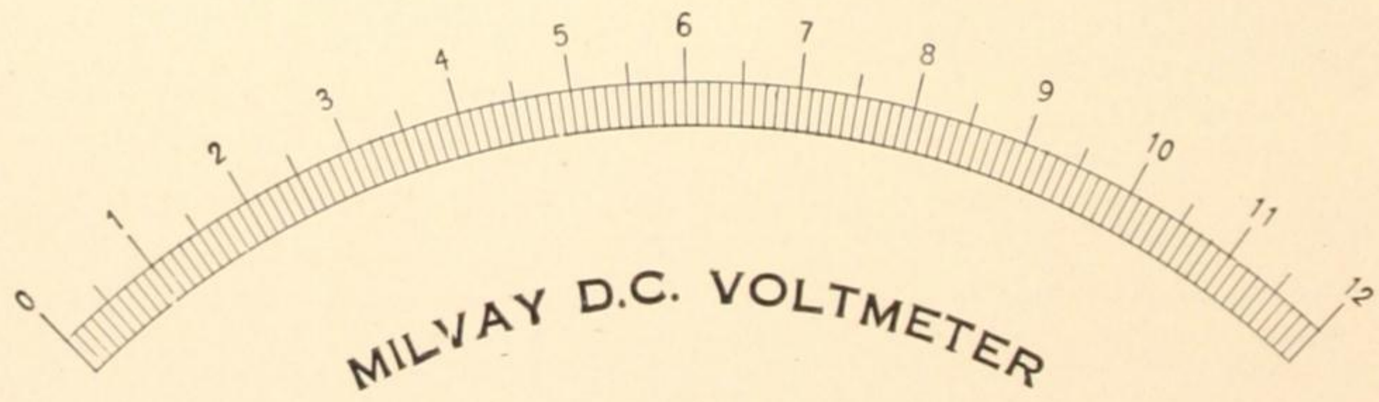
No.	A	B	C	D
Range, zero to, volts	3	15	150	300
Value of smallest division, volts	1/20	1/10	1	2
Each	**$17.50**	**17.50**	**17.50**	**17.50**

727E. Jewell-Milvay Voltmeters, Double Range—

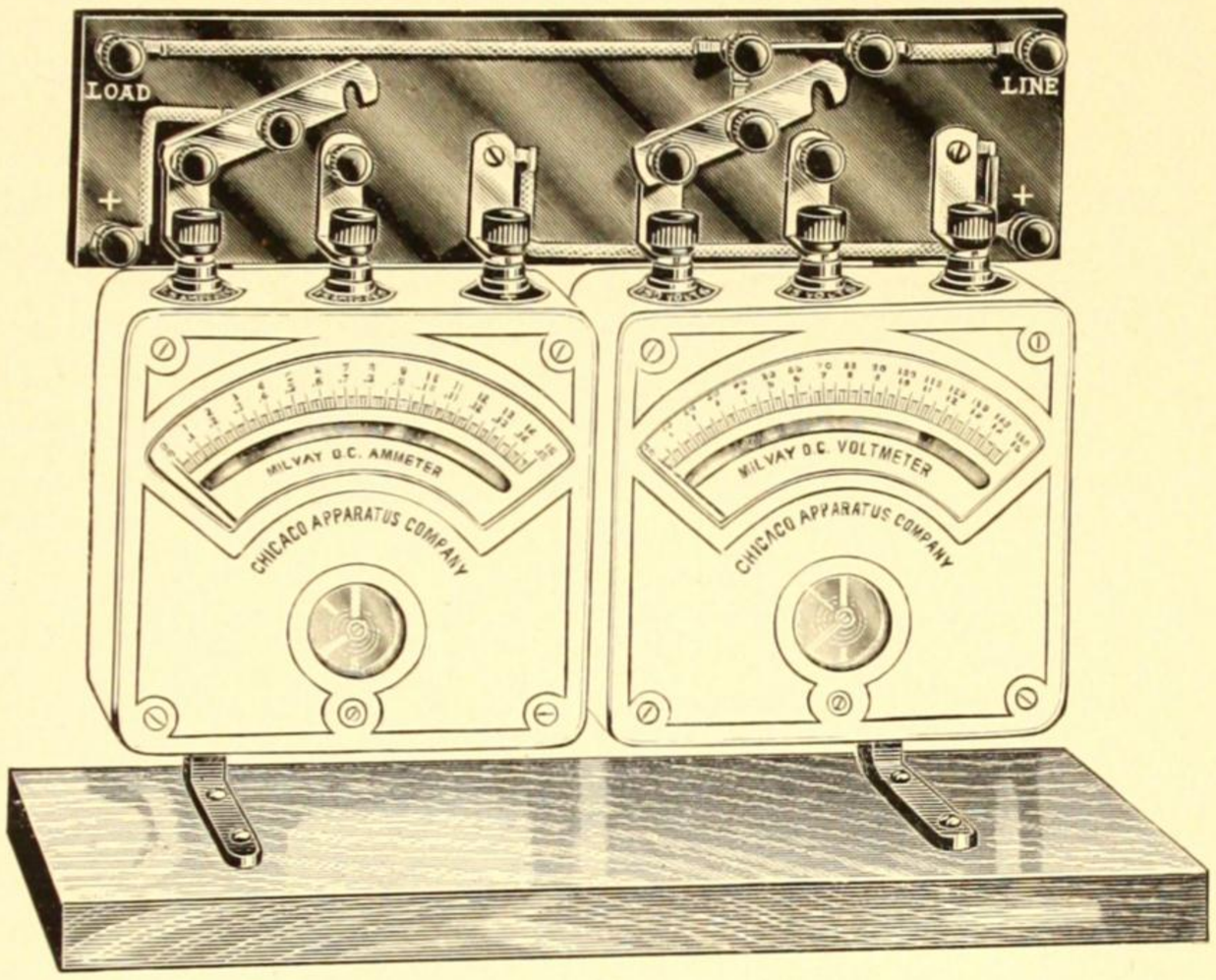
No.	A	B	C
Range, zero to, volts	1.5 & 15	3 & 30	15 & 150
Value of smallest division, volts	1/100 & 1/10	1/50 & 1/5	1/10 & 1
Each	**$20.00**	**20.00**	**20.00**

728E. Jewell-Milvay Volt-ammeter, Combined Instrument. Ranges 0 to 15 volts in 1/10 volt divisions and 0 to 15 amperes in 1/10 ampere divisions..... **$20.00**

Typical Scale of Jewell-Milvay D.C. Meters—Note the Large, Easy-Reading Divisions



Milvay Experimental Switchboard



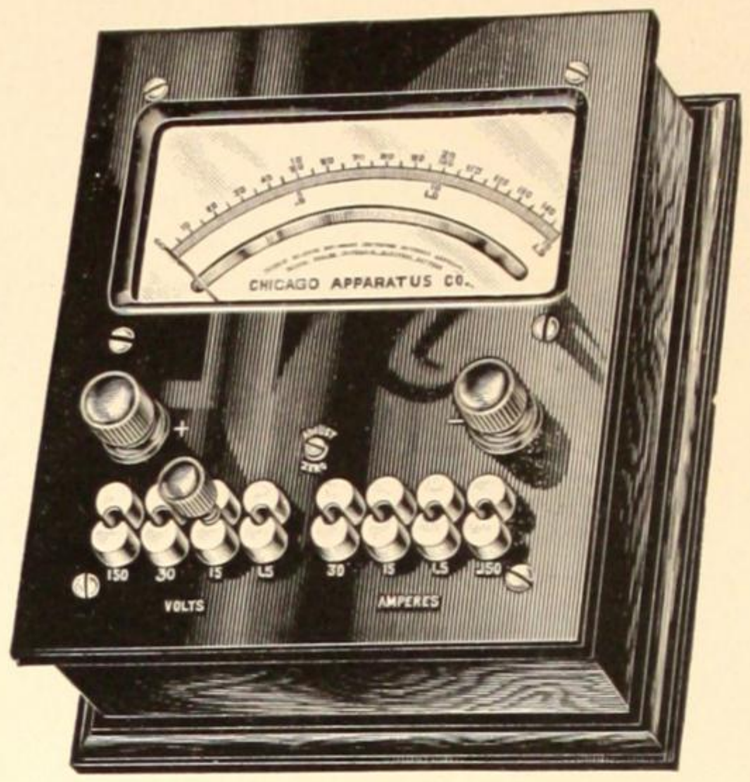
No. 2430E.

2430E. Experimental Switchboard, Milvay. Designed by Prof. A. W. Auger, Tilden Technical High School, Chicago, Illinois. Consists of a suitable panel support upon which two double scale Jewell-Milvay meters are mounted. Ammeter reads to 1.5 amperes in 1/100ths and to 15 amperes in 1/10ths; voltmeter to 15 volts in 1/10ths and 150 volts in 1s. Two simple switches permit quick change from one range to the other.

A suitable fuse protects the instruments against overloads. This portable unit will be found convenient in general laboratory and lecture work such as: demonstrating the proper method of connecting ammeters and voltmeters into circuit, the purpose of fuses, the power consumption of various types and sizes of incandescent lamps, the power consumption of D.C. motors, the effect of load on voltage, etc. A turn of the instrument binding posts permits the removal of the meters for other laboratory service. Complete with two meters, as illustrated and described **$45.00**

2435E. Experimental Switchboard, Milvay. Same as 2430E, without meters..... **10.00**

No. 726E Milvay Eight Range D.C. Meter



No. 726E.

This new compact unit, designed by Jewell and Milvay engineers, makes available for the first time a meter with a full set of voltage and current ranges that is as easy and convenient to use as a single-range instrument. Its four voltage and four current ranges—eight ranges in all—cover every experimental need, making it valuable for lecture, student and research work. It offers a host of advantages not afforded by any other meter.

Utmost Convenience Because of Extreme Simplicity

The simple "plug-in" system—the unique and exclusive feature which distinguishes the MILVAY EIGHT RANGE METER from all others—places all ranges at the instant command of the operator. It provides a method for switching any range into circuit as quickly, easily, and accurately as a given resistance is introduced into circuit with a standard plug resistance box. A few seconds is all that is required to select the range best suited for the work in hand. There is no confusing multiplicity of binding posts—no lead connections to change. There are but two binding posts for connecting the instrument into circuit—no "press-for-volts" buttons to push. In short it is as easy to use as a single-range meter. Such simplicity and convenience have never before been attained in a multi-range instrument.

Widest Possible Range of Usefulness

It measures with equal facility the pressure of a 110-volt commercial circuit; the current consumption of one or more incandescent lamps; the voltage of dry cells, Daniell cells, Bunsen cells, storage batteries, student batteries, "B" batteries, radio power units; output of dynamos; input of motors; current consumption of radio tubes, heating devices, cooking utensils; and the characteristics of all circuits whose voltage and current fall within the ranges of the instrument. No other meter affords such a wide range of service—the service of eight separate instruments compacted into one single simple unit.

A Low Cost of Economical Instrument

The low price of this instrument—$45.00—figures but $5.63 per range. This compares with a price of $17.50 per range for single-range instruments and $10.00 per range for double-range instruments. Surely it is real economy to equip your laboratory with this new all-purpose MILVAY EIGHT RANGE METER.

LIST OF RANGES

(1) 0-150 volts in 1 volt divisions.
(2) 0-30 volts in 1/5 volt divisions.
(3) 0-15 volts in 1/10 volt divisions.
(4) 0-1.5 volts in 1/100 volt divisions.
(5) 0-30 amperes in 1/5 ampere divisions.
(6) 0-15 amperes in 1/10 ampere divisions.
(7) 0-1.5 amperes in 1/100 ampere divisions.
(8) 0-150 milliamperes in 1 M.A. (1/1000 amp.) divisions.

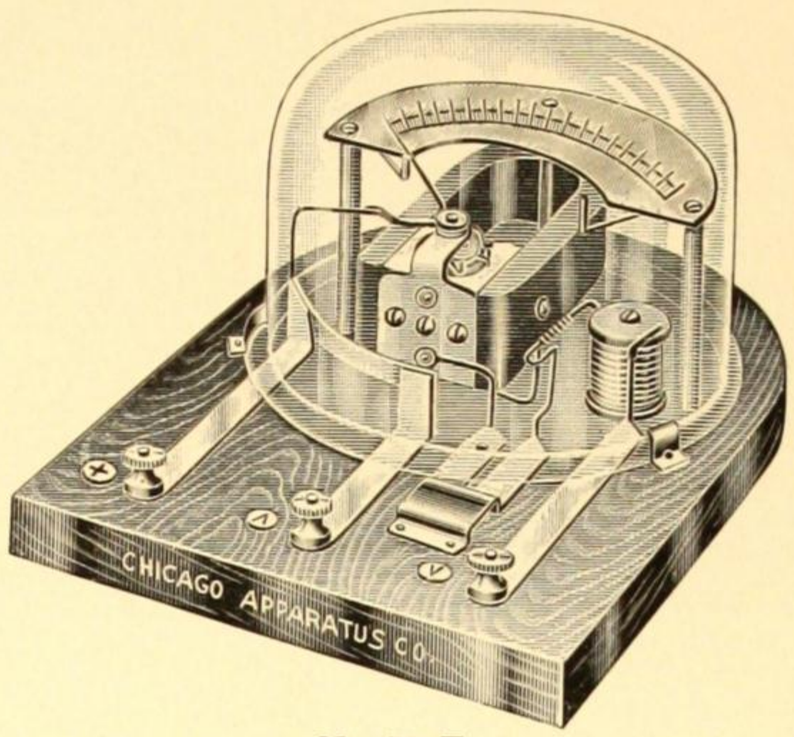
Specifications

Movement—Standard Jewell D'Arsonval Type with coil mounted in finest quality sapphire jewels.
Scale—Easy-reading type—4¼ inches long—150 divisions—marked with four series of figures as follows: 0-150, 0-30; 0-15, 0-1.5.
Voltmeter Resistance—About 100 ohms per volt or 1500 ohms for the 15-volt range.
Ammeter Resistance—About 0.005 ohm for the 15-ampere range.
Pointer—Knife-edge type swings over parallax mirror.
Zero Corrector—External adjustment type.
Contact Blocks—Brass, extra heavy, eight pairs with single travelling plug for plugging-in any desired range.
Top—Finest quality black Bakelite, with extra large window to provide maximum scale illumination.
Case—Of finely finished walnut.
Overall Dimensions—7½x6½x3¾ inches.
Guaranteed Accuracy—1%.

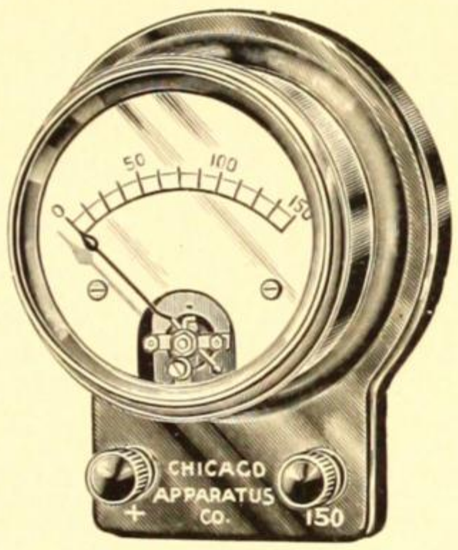
In every detail—material—workmanship—finish—appearance—this new Milvay-Jewell product reflects that quality so characteristic of fine scientific instruments. This, together with its low price, assures the purchaser a new high value in an electrical measuring instrument.

Price **$45.00**

729E. Meter, Demonstration, Milvay. Visible form. A volt-ammeter of the same design as our No. 728E, but mounted under a heavy glass dome, so that all parts are in plain view, as shown in the illustration. The entire construction is revealed to view, thus enabling the student to clearly understand the distinction between a voltmeter and an ammeter and to trace out all connections. When used as a voltmeter, connections are made to the post marked + and V. The current then passes from the post marked + through the moving coil and resistance coil to post V. When used as an ammeter, the connections are made to the posts marked + and A. The current passes from the post marked + to the post marked A, a small part of it flowing through the moving coil, most of it flowing through the low resistance shunt connected in parallel with the moving coil. The scale has a range of 10 volts in 1/10 volt divisions and 10 amperes by 1/10 ampere divisions. Calibration guaranteed to 1% of the full scale $22.50



No. 729E.



Nos. 2445E-2450E.

Jewell Hot Wire Ammeters

(New Thermo-Couple Type)

Measures with equal accuracy on direct, pulsating, or alternating currents of any frequency. Useful for testing antenna radiation, filament currents, and storage battery charging rates. In the ordinary hot wire ammeter expansion of a wire, which is heated by the current passing through it, communicates motion to the pointer through the medium of multiplying mechanism. The inherent disadvantages of this type—constant strain on the wire necessitating frequent resettings to "0," causing ultimate breakage; sticking of the mechanism causing errors; and extremely slow action—are overcome in this new type, which in commercial radio and wireless work is rapidly replacing the other. The action of this new ammeter is as follows:

The current passing through the instrument heats a thermo-couple which thus generates a D.C. current in a circuit into which a D'Arsonval movement has been connected. Since the pointer deflections are proportional to the current flow, the scale divisions are uniform throughout.

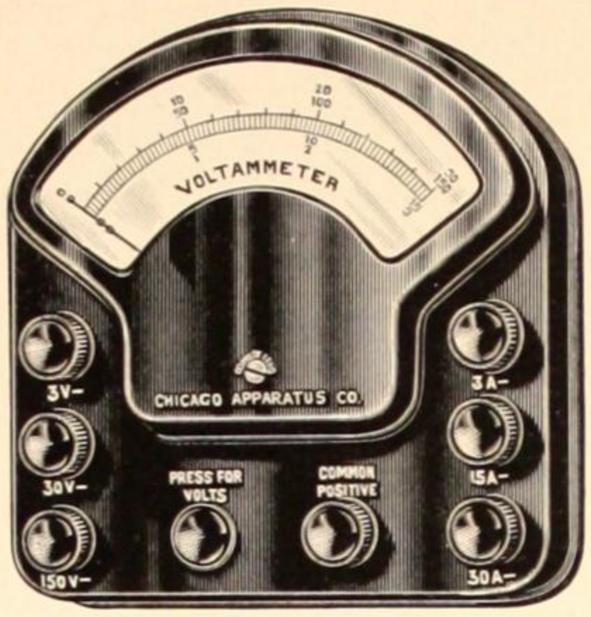
Thermo-couple and movement are enclosed in a black enameled metal case mounted on a precision molded Bakelite base. The full circle glass provides maximum scale illumination under all conditions. The absence of frail mechanism insures longer and more dependable service.

2445E. Milliammeters, Jewell Hot Wire.

No.	A	B	C
Range, milliamperes	100	250	500
No. of scale divisions	50	50	50
Each	**$16.50**	**15.50**	**14.85**

2450E. Ammeters, Jewell Hot Wire.

No.	A	B	C	D	E
Range, amperes	1	5	10	15	20
No. of scale divisions	50	50	50	75	40
Each	**$14.85**	**14.85**	**14.85**	**14.85**	**14.85**



No. 2485E.

Jewell D.C. Portable Meters

A fine portable for student's use. The extra long scale, 3 5/16 inches, the special magnetic shielding, finer electrical characteristics, and 50% more weight are a few of the features which distinguish this new instrument from other similar types.

The body is molded in one piece, having two compartments—one for the movement and series resistance, and the other for the shunts and calibrating resistances. Effective shielding against external magnetic influence is accomplished by a steel cover which completely incases the movement. A bakelite base closes the rear of the instrument. The movement is a special small watch-like pattern D'Arsonval. Its fine electrical characteristics are indicated by the high voltmeter resistance of about 100 ohms per volt or 1000 ohms for a 10-volt range, and the low resistance of 0.0075 ohms for a 10-ampere range. The pointer is of the anti-parallax knife edge pattern. Zero adjuster is of the simple external control type. Dimensions, 4¾x4¾x1¾ inches; weight, 25 ounces. Deservedly a very popular instrument with educational laboratories. Meters marked with an asterisk (*) best meet the needs of courses in elementary physics and electricity. Guaranteed accuracy 1%.

2455E. Milliammeters, Jewell D. C. Portable, Single Range—

	A	B	C	D	E	F	G	H
No.	50	75	100	150	250	300	500	750
Range, milliamperes	50	75	50	75	50	60	50	75
No. of scale divisions	$18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50
Each								

2460E. Ammeters, Jewell, D. C. Portable, Single Range—

	A	B	C	D*	E	F	G*	H	K*
No.	1	1.5	2	3	5	10	15	25	30
Range, amperes	50	75	40	60	50	50	75	50	60
No. of scale divisions	$18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50
Each									

2465E. Ammeters, Jewell D. C. Portable, Triple Range—

	A	B*	C	D	E	F
No.	5-2.5-0.25	10-1-0.1	10-5-0.5	10-2.5-1	15-3-0.15	15-3-1.5
Ranges, amperes	50	50	50	50	75	75
No. of scale divisions	$21.75	21.75	21.75	21.75	21.75	21.75
Each						
No.	G	H	K	L*	M	N*
Ranges, amperes	25-2.5-0.5	25-5-2.5	25-10-5	30-3-1.5	30-6-3	30-15-3
No. of scale divisions	50	50	50	60	60	60
Each	$21.75	21.75	21.75	21.75	21.75	21.75

2470E. Millivoltmeters, Jewell D. C. Portable, Single Range—

	A	B	C	D	E	F	G
No.	50	75	100	150	250	500	750
Range, millivolts	50	75	50	75	50	50	75
No. of scale divisions	$18.50	18.50	18.50	18.50	18.50	18.50	18.50
Each							

2475E. Voltmeters, Jewell D. C. Portable, Single Range—

	A	B	C*	D	E	F	G*	H
No.	1.2	1.5	3	5	7.5	10	15	30
Range, volts	60	75	60	50	75	50	75	60
No. of scale divisions	$18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50
Each								
No.	K	L	M	N	P	R*	S	
Range, volts	50	60	75	100	120	150	300	
No. of scale divisions	50	60	75	50	60	75	75	
Each	$18.50	18.50	18.50	18.50	18.50	18.50	29.00	

2480E. Voltmeters, Jewell D. C. Portable, Triple Range—

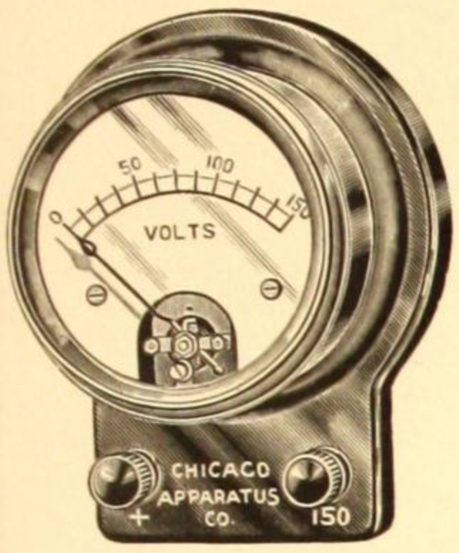
	A	B	C*	D	E	F
No.	25-10-2.5	30-3-1.5	30-15-3	50-5-2.5	50-25-5	100-25-2.5
Ranges, volts	50	60	60	50	50	50
No. of scale divisions	$21.75	21.75	21.75	21.75	21.75	21.75
Each						
No.	G	H	K*	L	M	N
Ranges, volts	100-50-5	150-15-1.5	150-15-3	150-30-3	150-75-3	150-75-15
No. of scale divisions	50	75	75	75	75	75
Each	$21.75	21.75	21.75	21.75	21.75	21.75

2485E. Volt-ammeters, Jewell D. C. Portable, Triple Range—

	A*	B	C	D	E	F
No.	1.5-3-30	3-15-30	2.5-5-50	1.5-15-150	1.5-15-150	1.5-15-150
Ranges, volts	1.5-3-30	0.15-3-15	0.1-1-10	0.15-1.5-15	1.5-3-30	1.5-15-30
Ranges, amperes	75	60	50	75	75	75
No. of scale divisions	$34.00	34.00	34.00	34.00	34.00	34.00
Each						
No.	G	H	K	L*	M	N
Ranges, volts	3-15-150	3-15-150	3-15-150	3-15-150	3-30-150	3-30-150
Ranges, amperes	0.15-1.5-15	1.5-3-15	1.5-3-30	3-15-30	1.5-15-30	.015-3-30
No. of scale divisions	75	75	75	75	75	75
Each	$34.00	34.00	34.00	34.00	34.00	34.00

Jewell Laboratory Meters

D.C. and A.C.—Accuracy 2 Per Cent



No. 2500E.

These inexpensive instruments have proven very popular in school, college, and radio work where a fair degree of accuracy is acceptable. The electrical characteristics are very good for instruments of such low cost—about 60 ohms per volt or 600 volts for a 10-volt range. This indicates a low current draw—about 17 M.A. for a full scale deflection—making them satisfactory for measuring the low current circuits employed in experimental laboratory work. The D.C. movements are of the D'Arsonval pattern and the A.C. of the Iron Vane type. They are inclosed in a black enameled metal case mounted on a precision moulded Bakelite base. The scale—2¼ inches long—is under a full circle glass which provides maximum illumination under all conditions. Air-tight sealing protects the movement against dust and moisture. No finer small portable instruments are available to schools at such low cost.

DIRECT CURRENT

2490E. Milliammeters, Jewell Laboratory, D. C., Single Range.

No.	A	B	C	D	E	F	G
Range, milliamperes	10	20	30	50	100	250	500
No. of scale divisions	50	40	30	50	50	50	50
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**

2495E. Ammeters, Jewell Laboratory, D.C., Single Range.

No.	A	B	C	D	E
Range, amperes	1	5	10	15	30
No. of scale divisions	50	50	50	75	30
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**10.00**

2500E. Voltmeters, Jewell Laboratory, D.C., Single Range.

No.	A	B	C	D	E	F
Range, volts	3	10	15	30	150	300
No. of scale divisions	30	50	30	30	75	60
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**11.00**	**13.50**

2505E. Voltmeters, Jewell Laboratory, D.C., Double Range.

No.	A	B
Ranges	12-120	15-150
No. of scale divisions	60	75
Each	**$12.50**	**12.50**

ALTERNATING CURRENT

2510E. Milliammeters, Jewell Laboratory, A.C., Single Range.

No.	A	B	C	D	E	F
Range, milliamperes	20	30	50	100	250	500
No. of scale divisions	40	30	50	50	50	50
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**

2515E. Ammeters, Jewell Laboratory, A.C., Single Range.

No.	A	B	C	D	E	F
Range, amperes	1	3	5	10	15	30
No. of scale divisions	50	30	50	50	75	30
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**

2520E. Voltmeters, Jewell Laboratory, A.C., Single Range.

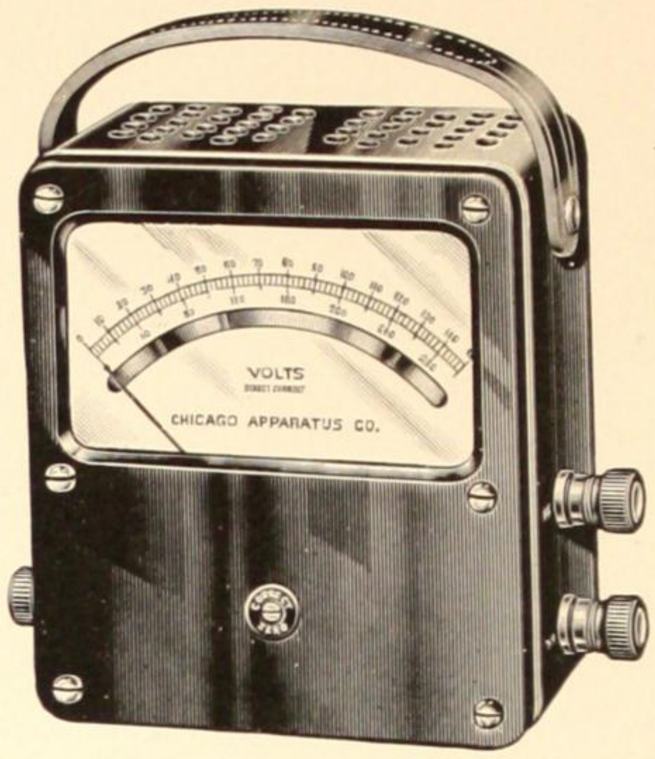
No.	A	B	C	D	E	F
Range, volts	10	15	30	50	150	300
No. of scale divisions	50	30	30	50	75	60
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**11.00**	**13.50**

2525E. Voltmeters, Jewell Laboratory, A.C., Triple Range.

No.	A
Ranges, amperes	3-15-150
No. of scale divisions	75
Each	**$15.00**

Jewell Master Meters

In D.C. and A.C. Models—Accuracy ½ Per Cent



No. 2555E.

These new portables are especially adapted to the needs of University, College, Technical School and Engineering Laboratories. In the High School laboratory they are ideal for teachers' demonstration work, lecture work, general laboratory work and for checking the accuracy of the less expensive meters used by students. In addition to the very fine electrical characteristics, Jewell Master Meters are truly masterpieces of the instrument-maker's art. In their production the finest materials and the most advanced manufacturing processes are utilized. The precision molded black Bakelite case and cover with a red Bakelite sealing gasket between them, the non-shatterable glass, and the perfect method of sealing against moisture and dust to protect the fine internal mechanism, are just a few examples of the refinements incorporated in these new instruments. The result is a meter of unrivaled beauty, utility, performance, accuracy, and value. The extra large opening in the cover provides better scale illumination under all conditions. The scale, $4\frac{7}{16}$" long, is hand drawn after calibration to eliminate the errors inherent in printed scales. The knife edge pointer swings over an anti-parallax mirror. The zero adjuster is of the external control type.

The resistance of D.C. voltmeters is very high—100 ohms per volt, or 1000 volts for a 10-volt range instrument. The resistance of the D.C. ammeters is correspondingly low—about .0075 ohms for a 10-ampere range instrument with proportionately lower resistances for higher ranges. Master movements are so responsive to small current impulses that it has been possible to build D.C. microammeters in this line. These are listed under No. 2530E. Also a special high resistance voltmeter with the enormous resistance of 2000 ohms per volt is listed and described under No. 2565E. These special instruments will be found valuable in testing circuits carrying extremely small currents.

In the A.C. instruments an improved iron vane movement is employed in which the pointer deflection is proportionate to the current in the coil. Good damping is obtained by means of a light fan blade attached to the moving system and operating in a sector-shaped chamber. The series voltmeter resistance is 30 ohms per volt at 150 ohms, a characteristic typical only of precision instruments. The ammeter resistance is correspondingly low.

The mechanical and electrical properties of this new line of portable meters are so fine that it has made possible the most complete series of instruments for D.C. and A.C. current and potential measurements. They are listed below. In addition, it has made possible a series of wattmeters for power measurements. These are listed on the following page.

DIRECT CURRENT

2530E. Microammeters, Jewell Master, D.C., Single Range.

No.	A	B	C
Range, microamperes	200	300	500
No. of scale divisions	100	150	100
Each	**$58.00**	**55.00**	**50.00**

2535E. Milliammeters, Jewell Master, D. C., Single Range.

No.	A	B	C	D	E	F	G
Range, milliamperes	1	5	25	100	200	300	500
No. of scale divisions	100	100	125	100	100	150	100
Each	**$40.00**	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**

2540E. Ammeters, Jewell Master, D.C., Single Range.

No.	A	B	C	D	E	F	G
Range, amperes	1	3	5	15	30	50	75
No. of scale divisions	100	150	100	150	150	100	150
Each	**$35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**38.00**

2545E. Millivoltmeters, Jewell Master, D. C., Single Range.

No.	A	B	C	D
Range, millivolts	25	75	100	150
No. of scale divisions	125	150	100	150
Each	**$35.00**	**35.00**	**35.00**	**35.00**

2550E. Voltmeters, Jewell Master, D.C., Single Range.

No.	A	B	C	D	E	F	G
Range, volts	3	15	30	50	125	150	250
No. of scale divisions	150	150	150	100	125	150	125
Each	**$35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**37.50**

2555E. Voltmeters, Jewell Master, D.C., Double Range.

No.	A	B	C	D
Ranges, volts	3-30	15-150	75-150	150-300
No. of scale divisions	150	150	150	150
Each	**$37.00**	**37.00**	**37.00**	**40.00**

2560E. Voltmeters, Jewell Master, D.C., Triple Range.

No.	A	B	C
Ranges, volts	3-15-150	15-30-150	15-150-300
No. of scale divisions	150	150	150
Each	**$39.00**	**39.00**	**41.25**

2565E. Voltmeter, Jewell Master, D.C., Triple Range. Special high resistance type especially designed for measuring the voltage of radio and other circuits in which but very small amounts of current are flowing. Also for testing the open circuit potentials of "B" power supply units and other devices generating or delivering small currents rated in milliamperes. Requires but 0.5 milliampere draw for full scale deflection and therefore gives good readings in circuits carrying as little as 10 milliamperes of current. Resistance is 2000 ohms per volt for all ranges. Reads 0-50, 0-250, and 0 to 500 volts. Number of scale divisions—100 ..... **$100.00**

ALTERNATING CURRENT

2570E. Milliammeters, Jewell Master, A.C., Single Range. Same as Nos. 2530E to 2565E, but with dynamometer movement for alternating current.

No.	A	B	C	D	E	F	G
Range, milliamperes	25	50	75	100	200	300	500
No. of scale divisions	125	100	150	100	100	150	100
Each	**$27.25**	**27.25**	**27.25**	**27.25**	**27.25**	**27.25**	**27.25**

2575E. Ammeters, Jewell Master, A.C., Single Range.

No.	A	B	C	D	E	F	G
Range, amperes	1	3	5	15	30	50	75
No. of scale divisions	100	150	100	150	150	100	150
Each	**$27.25**	**27.25**	**27.25**	**27.25**	**27.25**	**27.25**	**32.25**

2580E. Ammeters, Jewell Master, A.C., Double Range.

No.	A	B	C	D
Ranges, amperes	1-2	2.5-5	5-10	10-20
No. of scale divisions	150	100	100	100
Each	**$38.75**	**38.75**	**38.75**	**38.75**

2585E. Ammeters, Jewell Master, A.C., Triple Range.

No.	A	B	C
Ranges, amperes	1.5-7.5-15	2.5-5-10	2-5-20
No. of scale divisions	75	100	100
Each	**$58.50**	**58.50**	**58.50**

2590E. Voltmeters, Jewell Master, A.C., Single Range.

No.	A	B	C	D	E	F	G
Range, volts	3	15	30	50	75	150	250
No. of scale divisions	150	150	150	100	150	150	125
Each	**$29.25**	**29.25**	**29.25**	**29.25**	**29.25**	**29.25**	**31.25**

2591E. Voltmeters, Jewell, Master, A.C., Double Range.

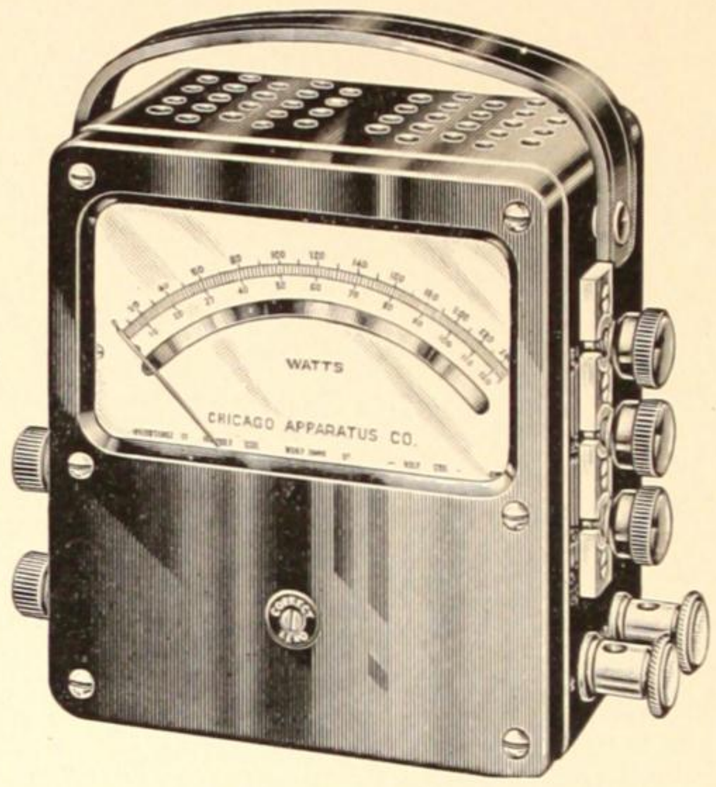
No.	A	B	C	D	E	F
Ranges, volts	6-30	8-16	15-60	75-150	150-300	300-750
No. of scale divisions	150	80	150	150	150	150
Each	**$36.75**	**36.75**	**36.75**	**36.75**	**38.25**	**42.75**

2592E. Voltmeter, Jewell Master, A.C., Triple Range.

Ranges, volts	3-15-150
No. of scale divisions	150
Each	**$51.00**

Jewell Master Portable Wattmeters

In D.C. and Single Phase A.C. Models
Accuracy ½ Per Cent



Nos. 2595E-2600E.

A positive necessity for measuring the power in the circuits of bell-ringing and experimental transformers; bulb, electrolytic, and copper oxide rectifiers; arc and incandescent lamps; choke coils; toasters; percolators; and other A.C. devices. Also useful in impedance, power factor, and operating efficiency experiments. Because of the "lag" or "lead" in alternating currents the true power as measured by the wattmeter is less than the apparent power (volts times amperes) measured by the voltmeter and ammeter method. In experimental transformer circuits the difference is often very large. Thus with a power factor of 65% the volt-ammeter method will give 10 volt-amperes whereas a wattmeter will indicate the true power to be 6.5 watts. This example is by no means extreme and illustrates the importance of the wattmeter as a means for obtaining accurate power measurements. The growing practice of manufacturers to rate A.C. electrical equipment, utensils, and appliances in "volt-amps" instead of watts, as heretofore, is due to the growing knowledge that watt ratings are incorrect when the power factor of the circuit on which they are used is less than unity. The reason for the change can best be shown experimentally by comparing volt-ammeter with wattmeter power measurements for identical A.C. circuits.

In D.C. work, wattmeters are useful for checking the accuracy of results obtained by the volt-ammeter method. In lecture and demonstration work they are more convenient than two separate instruments, besides they save time and calculations.

Nos. 2595E and 2600E are Double-Range instruments with two potential coils and one current coil.

Nos. 2605E and 2610E are Triple-Range instruments having two potential coils and a current coil so tapped that its two halves may be connected in series or parallel, thereby providing the third range.

The metal link system ordinarily employed in wattmeters for changing the current coil sections from series to multiple connection has been replaced by four contact blocks and three large thumb screws. The new system is simple, quicker and loss-proof.

To assure full scale deflections even in circuits in which the power factor is as low as 65%, both potential and current coils have been designed to carry 50% above their normal ratings continuously.

The electrical characteristics of Master Wattmeters are such that they may be used interchangeably on D.C. and Single Phase A.C. circuits with results of equal accuracy. Laboratories can buy no finer Wattmeters at any price.

2595E. Wattmeters, Jewell Master Portable, Double Range. For use on A.C. Single Phase and D.C. circuits up to 75 volts and up to 150 volts. (Normal rating.)

No.	A	B	C	D	E	F
Watts, Low Range	0-75	0-150	0-375	0-750	0-1500	0-3750
Watts, High Range	0-150	0-300	0-750	0-1500	0-3000	0-7500
No. of scale divisions	75	60	75	75	60	75
Normal volts	75-150	75-150	75-150	75-150	75-150	75-150
Maximum Volts	110-225	110-225	110-225	110-225	110-225	110-225
Normal amperes	1	2	5	10	20	50
Maximum amperes	1.5	3	7.5	15	30	75
Each	**$49.50**	**49.50**	**49.50**	**49.50**	**49.50**	**49.50**

2600E. Wattmeters, Jewell Master Portable, Double Range. For use on A.C. Single Phase and D.C. circuits up to 150 volts and up to 300 volts. (Normal rating.)

No.	A	B	C	D	E	F
Watts, Low Range	0-150	0-300	0-750	0-1500	0-3000	0-7500
Watts, High Range	0-300	0-600	0-1500	0-3000	0-6000	0-15000
No. of scale divisions	75	60	75	75	60	75
Normal volts	150-300	150-300	150-300	150-300	150-300	150-300
Maximum Volts	225-450	225-450	225-450	225-450	225-450	225-450
Normal amperes	1	2	5	10	20	50
Maximum amperes	1.5	3	7.5	15	30	75
Each	**$57.00**	**57.00**	**57.00**	**57.00**	**57.00**	**57.00**

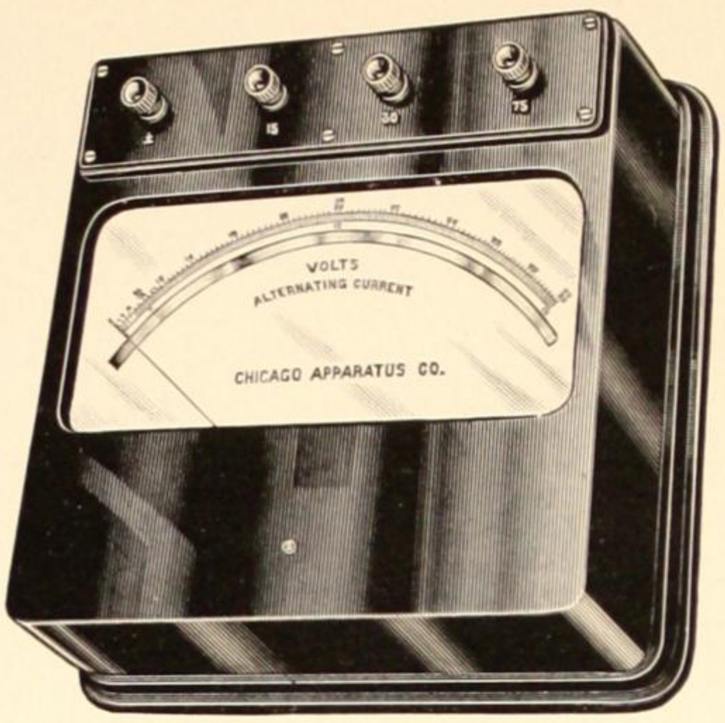
2605E. Wattmeters, Jewell Master Portable, Triple Range. For use on A.C. Single Phase and D.C. circuits up to 75 volts and up to 150 volts. (Normal rating.)

No.	A	B	C	D
Watts, Series, Low Range	0-75	0-187.5	0-375	0-750
Watts, Series, High Range } Watts, Multiple, Low Range }	0-150	0-375	0-750	0-1500
Watts, Multiple, High Range	0-300	0-600	0-1500	0-3000
No. of scale divisions	75	75	75	75
Normal volts	75-150	75-150	75-150	75-150
Maximum volts	110-225	110-225	110-225	110-225
Normal amperes, series	1	2.5	5	10
Maximum amperes, series	1.5	3.75	7.5	15
Normal amperes, multiple	2	5	10	20
Maximum amperes, multiple	3	7.5	15	30
Each	**$64.50**	**64.50**	**64.50**	**64.50**

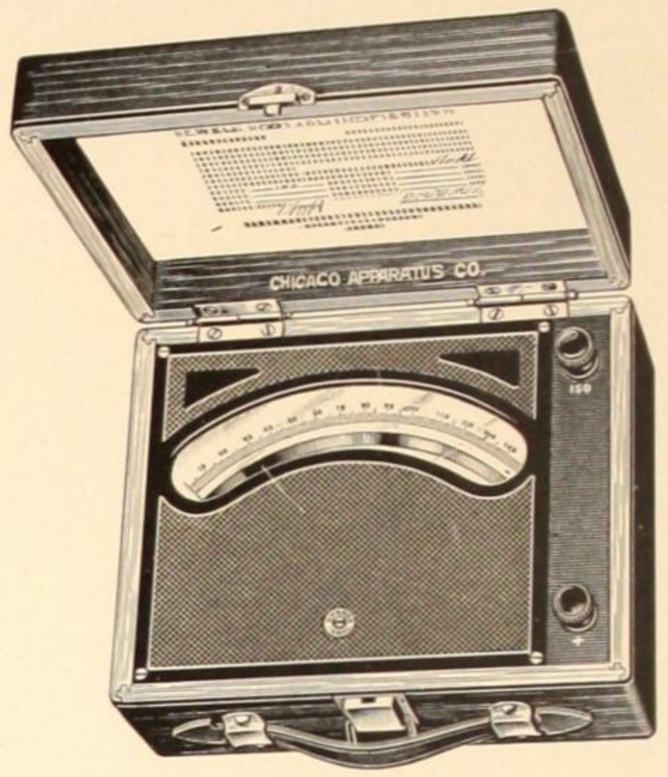
2610E. Wattmeters, Jewell Master Portable, Triple Range. For use on A.C. Single Phase and D.C. circuits up to 150 volts and up to 300 volts.

No.	A	B	C	D
Watts, Series, Low Range	0-150	0-375	0-750	0-1500
Watts, Series, High Range } Watts, Multiple, Low Range }	0-300	0-750	0-1500	0-3000
Watts, Multiple, High Range	0-600	0-1500	0-3000	0-6000
No. of scale divisions	75	75	75	75
Normal volts	150-300	150-300	150-300	150-300
Maximum volts	225-450	225-450	225-450	225-450
Normal amperes, series	1	2.5	5	10
Maximum amperes, series	1.5	3.75	7.5	15
Normal amperes, multiple	2	5	10	20
Maximum amperes, multiple	3	7.5	15	30
Each	**$72.00**	**72.00**	**72.00**	**72.00**

Precision Standards



No. 2630E.



No. 2640E.

Meters, Jewell, D.C. Accuracy 1/10%. Finest quality instruments for testing, calibrating, research and other work requiring the very highest order of accuracy. Potentiometer and standard cell calibration, hand drawn scale, knife-edge pointer, anti-parallax mirror, large non-shatterable window, finest D'Arsonval movement, zero adjuster. Resistance, 100 ohms per volt; scale, 10¼ inches long; dimensions, 12¼x12⅝x4¼ inches; weight, 16 lbs.

2615E. Ammeters, Jewell, D.C.

No.	A	B	C	D
Range, amperes	5	10	15	30
No. of scale divisions	250	200	300	300
Each	$155.00	155.00	155.00	155.00

2620E. Voltmeters, Jewell, D.C.

No.	A	B	C	D	E
Range, volts	3	15	75	150	300
No. of scale divisions	300	300	300	300	300
Each	$150.00	150.00	150.00	150.00	153.25

Meters, Jewell, A.C. Same as Nos. 2615E and 2620E, but with dynamometer movement for alternating current.

2625E. Ammeters, Jewell, A.C.

No.	A	B	C	D
Range, amperes	5	10	15	30
No. of scale divisions	250	200	300	300
Each	$177.75	177.75	177.75	177.75

2630E. Voltmeters, Jewell, A.C.

No.	A	B	C
Range, volts	75	150	300
No. of scale divisions	300	300	300
Each	$175.00	175.00	178.75

Meters, Jewell, D.C. Accuracy ¼%. These rugged instruments are suitable for all kinds of general laboratory work—testing, checking, calibrating, etc.—where high accuracy is important. Built for hard and constant service. Hand drawn scale, knife-edge pointer, anti-parallax mirror, finest D'Arsonval movement, zero adjuster, rugged walnut case. Scale, 6¾ inches long; dimensions, 8¾x7⅛x4⅞ inches, weight, 6½ pounds.

2635E. Ammeters, Jewell, D.C.

No.	A	B	C	D	E	F
Range, amperes	1	5	15	30	50	75
No. of scale divisions	100	100	150	150	100	150
Each	$45.00	45.00	45.00	45.00	45.00	45.00

2640E. Voltmeters, Jewell, D.C.

No.	A	B	C	D	E
Range, volts	3	15	75	150	300
No. of scale divisions	150	150	150	150	150
Each	$45.00	45.00	45.00	45.00	47.50

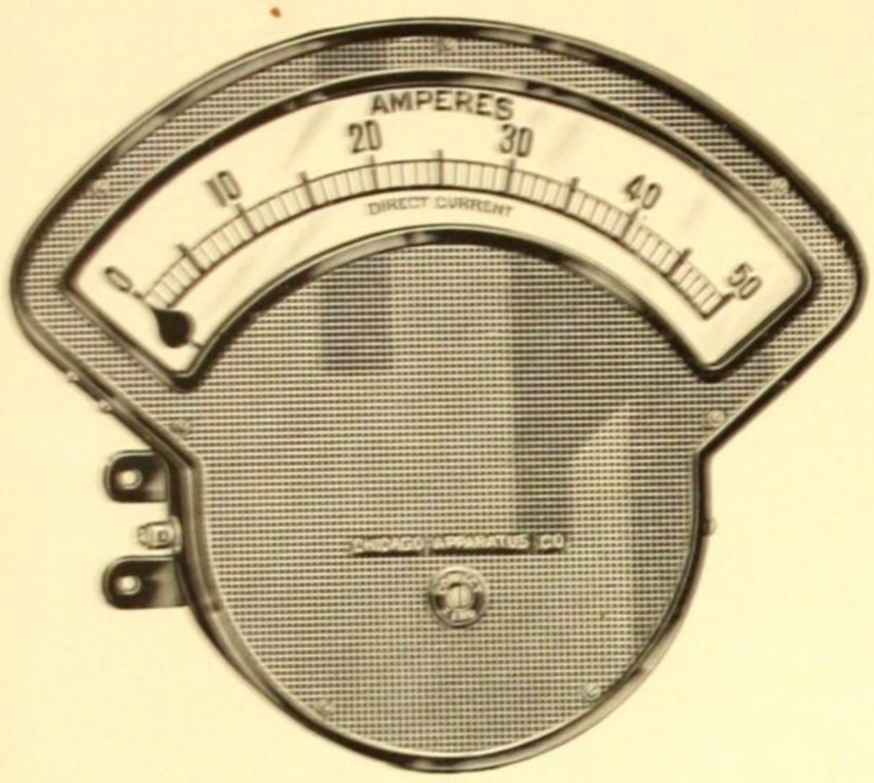
Meters, Jewell, A.C. Accuracy ¼%. Same as Nos. 2635E and 2640E, but with dynamometer movement for alternating current.

2645E. Ammeters, Jewell, A.C.

No.	A	B	C	D	E	F
Range, amperes	1	5	15	30	50	75
No. of scale divisions	100	100	150	150	100	150
Each	$36.00	36.00	36.00	36.00	36.00	36.00

2650E. Voltmeters, Jewell, A.C.

No.	A	B	C	D
Range, volts	15	75	150	300
No. of scale divisions	150	150	150	150
Each	$36.00	36.00	36.00	40.50



No. 2660E.

ILLUMINATED DIAL METERS

Extra large instruments that are particularly well adapted for lecture work. The size of the scale—12 inches long—insures ease of reading from any point in the largest lecture room. Two sockets for the lamps employed in illuminating the dial are placed in the rear of the glass scale so that they may be readily connected into the lighting circuit. Two metal straps as shown are provided for mounting the instrument in front of a board or panel. Accuracy 1%.

2660E. Ammeter, Jewell, Illuminated Dial, D.C.

No.	A	B	C	D
Range, amperes	5	10	30	50
No. of scale divisions	75	50	60	50
Each	**$90.00**	**90.00**	**90.00**	**90.00**

2665E. Voltmeter, Jewell, Illuminated Dial, D.C.

No.	A	B	C	D
Range, volts	75	150	250	500
No. of scale divisions	75	75	50	50
Each	**$90.00**	**90.00**	**92.00**	**95.00**

2670E. Ammeters, Jewell, Illuminated Dial, A.C.

No.	A	B	C	D
Range, amperes	5	10	30	50
No. of scale divisions	75	50	60	50
Each	**$105.00**	**105.00**	**105.00**	**105.00**

2675E. Voltmeters, Jewell, Illuminated Dial, A.C.

No.	A	B	C	D
Range, volts	75	150	250	500
No. of scale divisions	75	75	50	50
Each	**$105.00**	**105.00**	**107.00**	**110.00**

2680E. Galvanometer, Jewell, Illuminated Dial, D.C. The internal resistance is exactly one ohm. It will, therefore, serve three purposes: (1) As a Galvanometer with a sensitivity of one scale deflection for one volt through 1000 ohms. (2) As a Milliammeter with a range of 25 M.A. in 1-M.A. divisions. (3) As a Millivoltmeter with a range of 25 M.V. in 1-M.V. divisions. The scale is of the center zero type with 25 divisions on each side..... **$105.00**

RADIO TESTING METERS

2685E. Voltmeter, Jewell Radio, D.C. Accuracy 2%. This instrument because of its extremely high resistance—1000 ohms per volt—will measure within its rated accuracy the output of "B" Eliminators and "B" Batteries, as well as the potential of circuits in which small currents rated in milliamperes are flowing. In addition, it is also useful for measuring all ordinary D.C. circuits, the potentials of which fall within its ranges. The ordinary voltmeter with a resistance of approximately 100 ohms per volt consumes practically ten times more current than this special meter and when used in low current circuits, reads from 10% to 50% or more below the true voltage. The low range reads from 0-50 volts in 1-V. divisions and the high range from 0-250 volts in 5-V. divisions. While primarily a portable instrument, it has screw holes in the base for permanent mounting on panel or wall when so desired..... **$22.50**

2690E. Voltmeter, Jewell Radio, D.C. Accuracy 2%. Same as No. 2685E, but with a low range of 0-250 volts in 5-V. divisions and a high range of 0-500 volts in 10-V. divisions..... **$32.00**

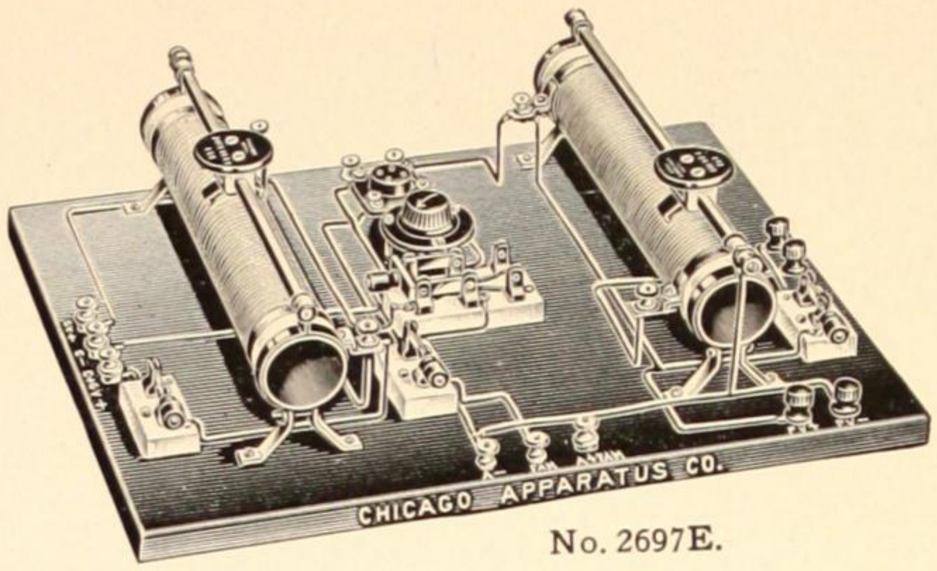
2695E. Voltmeter, Jewell Radio A.C. Accuracy 2%. Consumes far less current than the ordinary A.C. meter and is, therefore, particularly well suited for testing the potentials of radio circuits, such as the output circuits of A.C. power units, primary and secondary circuits of radio transformers, filament circuits of A.C. tubes, and other circuits in which the current flow is so feeble that instruments of ordinary type indicate, if at all, from 10-50% or more below the true voltage. In addition, it may also be used for measuring any A.C. circuit, such as lighting circuits, alternating current generator circuits, rectifier input circuits, etc., the voltage of which falls within its ranges. Being a triple range instrument it is particularly well suited for general laboratory A.C. circuit work. The three ranges are as follows: 0-3, 0-15, and 0-150 volts. While primarily a portable instrument, it has screw holes in the base for permanent mounting on panel or wall when so desired..... **$15.00**



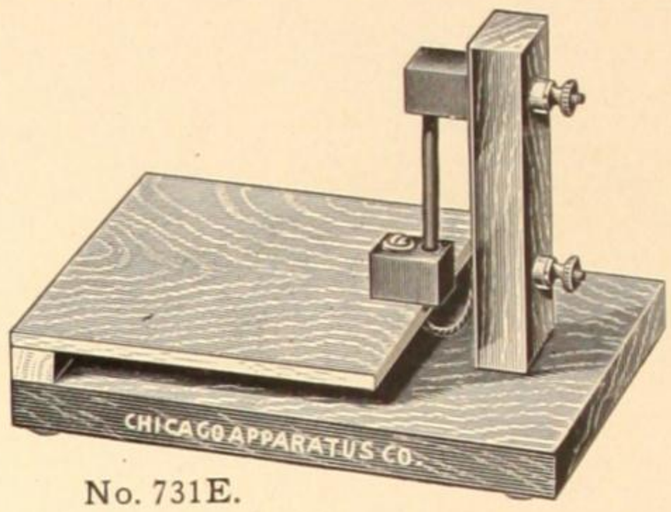
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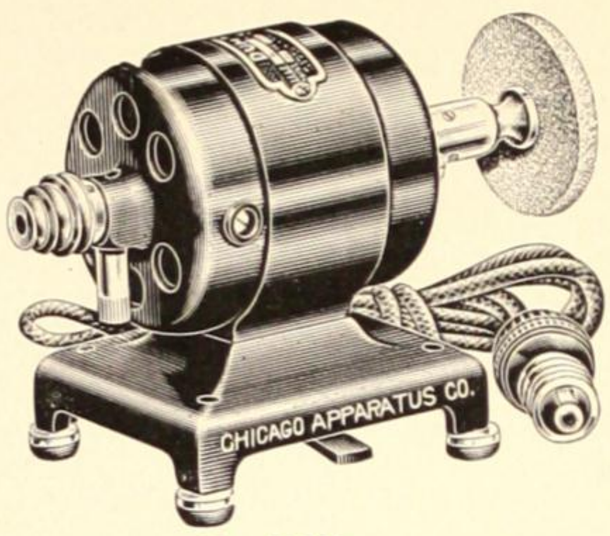
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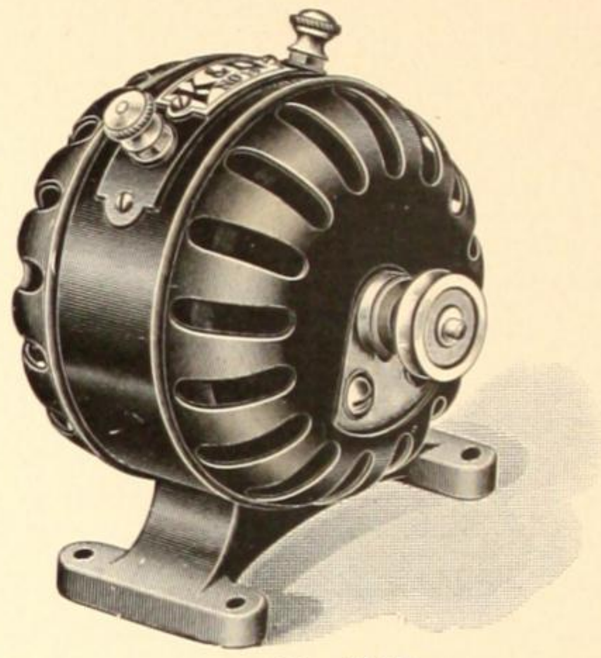
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No. 731E.



No. 732E.



No. 733E.

2697E. Vacuum Tube Testing Outfit. For measuring vacuum tube characteristics as outlined in Exp. 38 of Taylor, Watson and Howe's "General Physics for the Laboratory." With this set the grid voltage, plate voltage, and filament current may be varied at will. In addition, the grid voltage may be applied in either direction. The rheostats, switches, and binding posts, mounted on a neat insulating base, are all marked to correspond with the wiring diagram on page 159 of Taylor, Watson and Howe's manual. Connection to the current sources and meters is thereby facilitated.

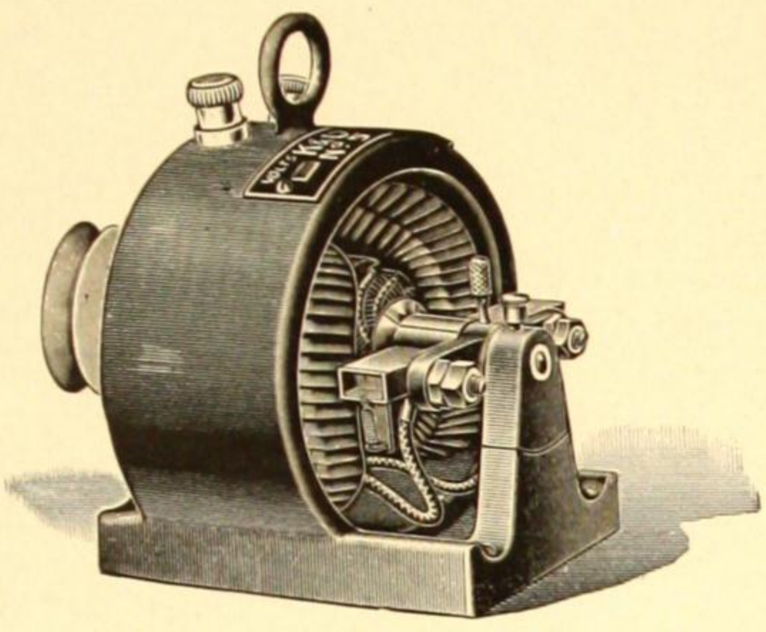
Complete, as illustrated, on 38x50 cm. base, but without tube **$32.00**

731E. Microphone, Milvay Improved Form with Sounding Board. In older forms there is no sounding board and both carbon blocks are rigidly secured to the upright. Such microphones to function at all must be affected by sound waves powerful enough to cause the entire apparatus to vibrate. In the Improved Milvay Microphone one carbon block is attached to a sounding board sensitive to very faint sound vibrations, while the other is rigidly fastened to the upright. This exclusively Milvay construction is naturally far more responsive than the old, and actual tests in our own laboratory show that if a watch is placed on the sounding board, a greatly magnified "tick" is heard in a telephone receiver like our No. 983E when connected in series with the microphone and two dry cells like our No. 113E. By placing the microphone and connected telephone receiver in different parts of the laboratory or in different rooms it is possible to transmit sound waves electrically over distances, the same as in an ordinary telephone system. When the sounding board is subjected to sound waves, the mechanical resistance of the loose electrode, due to its weight, serves to vary the pressure at the contact, and this gives the current a form corresponding to the sound waves. Present-day telephone transmitters work essentially on this important principle. Mounted on neatly finished 14x16 cm. base..... **$4.00**

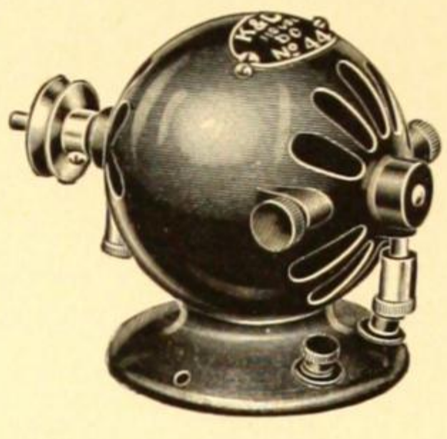
NOTE: For telephonic microphone with Induction Coil see page 135.

732E. Motor, Grinding. Universal type. Operates on either A.C. or D.C. 110-volt circuits. $\frac{1}{16}$ H.P. A light but powerful unit. As near trouble-proof as it is possible to build a motor. Equipment includes wheel arbor and emery wheel on one end of shaft, and a three-step pulley on the other, 8 ft. cord and attachment plug, five-speed rheostat in base. Finished in black enamel. Length over all, $4\frac{13}{32}$ inches, not including the shaft extension of $\frac{3}{4}$ inch at both ends. Diameter of shaft, $\frac{1}{4}$ inch. Diameter of motor, $3\frac{3}{8}$ inches. Measurement of base, $4\frac{1}{4}$x$3\frac{3}{4}$ inches. Net weight, $6\frac{1}{2}$ lbs..... **$20.00**

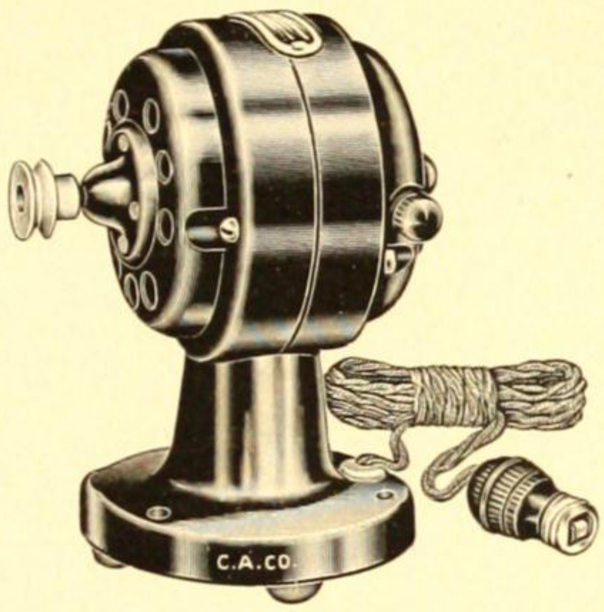
733E. Motor, K. & D. Battery type. For use on low voltage battery circuits. This motor is built on the lines of large machines. It stands $3\frac{3}{8}$ inches high and weighs 20 ounces. With the exception of the base, no cast iron is used in its construction. The field is made of the best charcoal iron annular field coil carefully taped and shellacked. The armature is laminated, slot wound. Self-lubricating bearings so constructed as to always be in perfect alignment, the cups having neat and efficient covers. Steel armature shaft with grooved brass pulley $\frac{5}{8}$ inch in diameter. The commutator segments are of hard copper, carefully insulated with mica—a feature rarely found in small motors. Self-adjusting brushes. The machine is perfectly ventilated. Frame and base finished in black enamel—not paint. For its size and weight this is the most powerful motor made **$5.00**



No. 2710E.



No. 2715E.



No. 735E.

2710E. Motor, K. & D., Power. Battery type. This machine is designed for actual work. It is designed on the lines of large machines and is constructed with care in every detail. The field is of the ring type, cast solid with the frame; coils are form wound. The armature is of the drum type, having 6 sections; it is laminated, best charcoal iron being used for the disks. The commutator segments are of hard copper, carefully insulated with mica. The brush holders are of the radial type on an adjustable yoke. The brushes are of woven wire and are self-adjusting. Finished in black enamel. Speed 1800 R.P.M. on a current of 2 amperes, 6 volts, with average load. Weight, 9 pounds. Length of shaft, 6 inches; diameter ¼ inch. Grooved pulley 1½ inches in diameter **$12.00**

2715E. Motor, K. & D. Universal type. For use on 110-volt A.C. or D.C. circuits. High grade construction throughout. Speed with average load, 2000 R.P.M. Shaft $\frac{3}{16}$ inch with 1 inch grooved pulley. Space occupied, 4¾x3¼x3¾ inches. Will develop 1/50th horsepower and will not heat up when operated continuously on either kind of circuit..... **$10.50**

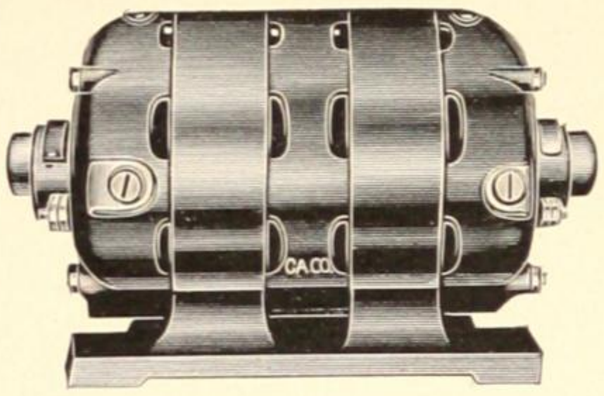
735E. Motor, Universal. Operates efficiently on either 110 volt D.C. or A.C. (60 cycle) current and develops about 1/50 H.P. The pulley is ¾ inches in diameter and is V-grooved for ⅛ to $\frac{3}{16}$ inch round belting. Fields and armature are laminated, and the latter is equipped with a heavy copper multi-section commutator, while the brushes are the finest quality spring-tension carbon type—¼ inch diameter. The substantial construction and provisions for oiling and ventilation prevent this motor from heating up, even if operated continuously over long periods. It weighs 4 lbs., is 6¼ inches high, consumes but 0.25 amperes, and is finely finished in black enamel. Complete with cord and plug..... **$9.50**

735Ed. Prony Brake Belt. For use with Nos. 732E, 733E, 2710E, 2715E, or 735E Motors. Of $\frac{3}{16}$-inch round belting, with chain links at both ends for convenience in varying the effective length. Overall length, 27.5 inches **$0.60**

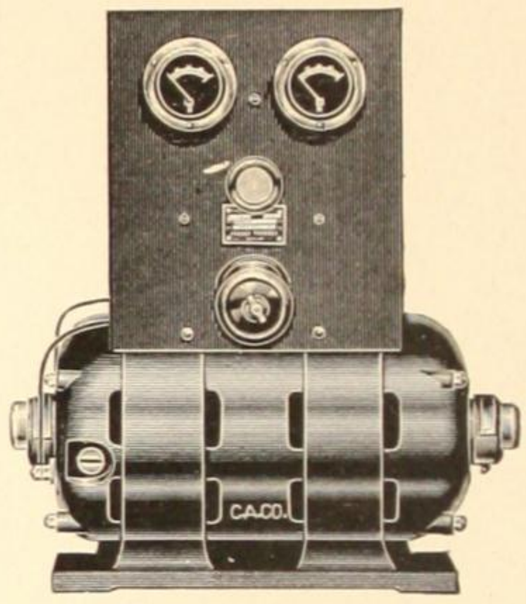
Dynamos are listed on pages 52 to 55.

Motor Generator Sets

A.C. to D.C.



Nos. 2720E-2820E.



No. 2825E.

Much laboratory lecture work requires direct current; the charging of storage batteries, the operation of induction coils, electrolysis work, the operation of powerful magnets, efficiency tests of D.C. motors, and of other D.C. devices, are typical examples. In laboratories where the regular supply is alternating current, a motor-generator set provides the easiest, simplest, most convenient and most dependable means for furnishing the necessary direct current. Because of the lack of complete specifications and data on motor-generator sets available, it has always been difficult to select the outfit best suited for the work to be done in the laboratory. To assist prospective purchasers in making the proper selection, we list below five groups of motor generators in output sizes from 50 to 750 watts. Under each group we list the voltage and amperage output-combinations in which they are available. In addition, complete data is given for the motor used in combination with the generator and which motor in every case has sufficient power to deliver the full rated output of the generator.

In selecting a motor generator set, the first consideration is the maximum voltage and maximum amperage required. Thus if it is desired to operate an arc lamp, the current consumption of which is usually 4½ amperes at 45 volts, the 4½-ampere-110-volt-500-watt outfit No. 2800E should be ordered. If the maximum requirement involves the charging of a 6-volt storage battery, the current required would be 7.5 volts and 6 to 8 amperes. The 12-volt-13-amperes-150-watt outfit No. 2750E covers this need.

In short, the motor generator selected should cover the maximum simultaneous voltage and amperage requirement, which in turn will determine the watt size of the outfit. Thus, if the maximum requirement is 9½ amperes at 32 volts, this amount of current could not be supplied by an outfit smaller than 300 watts. If, however, the maximum requirement be only 5 amperes at 30 volts, a 150-watt outfit would meet the condition.

For the sake of simplicity in ordering, a catalogue number has been assigned to each and every outfit, and this number should be stated when ordering. The motors in each outfit are so designed that by the change of a simple connection, which any one can make in a few minutes by following the directions attached to the motor, it can be adapted for operation on either 110 or 220-volt—60-cycle alternating current. The motor generators here listed are of the latest Non-stalling, Cool-running, High-efficiency Type.

The brushes are well insulated and the motors being of the induction type are equipped with an efficient short circuiting device, a starting necessity in motors of this type. They are equipped with a slow circulating

Motor Generator Sets—Cont.

filtering lubrication system. An ingenious device provides effective ventilation. They are economical because the design is such that all active material is employed to gain the utmost in strength and efficiency. The fine workmanship, materials, and finishes employed give these outfits a high-class appearance. Generator and motor are united into one housing, thus making them very compact. Screw holes in the base legs and external terminals conveniently located, make installation simple and easy.

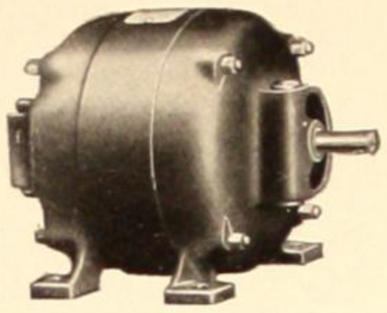
	Generator Output Specifications			Motor Specifications		
Cat. No.	Watt Size	Max. Voltage	Max. Amp.	H. P. Rating	Will Operate On	Each
2725E.	50	12	4.0	1/8	110 or 220 Volts A.C.	$65.00
2730E.	50	18	3.0	1/8	110 or 220 Volts A.C.	65.00
2735E.	50	24	2.0	1/8	110 or 220 Volts A.C.	65.00
2740E.	50	32	1.5	1/8	110 or 220 Volts A.C.	65.00
2745E.	50	110	0.5	1/8	110 or 220 Volts A.C.	65.00
2750E.	150	12	13.0	1/3	110 or 220 Volts A.C.	75.00
2755E.	150	18	8.5	1/3	110 or 220 Volts A.C.	75.00
2760E.	150	24	6.5	1/3	110 or 220 Volts A.C.	75.00
2765E.	150	32	5.0	1/3	110 or 220 Volts A.C.	75.00
2770E.	150	110	1.4	1/3	110 or 220 Volts A.C.	75.00
2780E.	300	24	12.5	3/4	110 or 220 Volts A.C.	105.00
2785E.	300	32	9.5	3/4	110 or 220 Volts A.C.	105.00
2790E.	300	110	2.7	3/4	110 or 220 Volts A.C.	105.00
2794E.	500	24	21.0	1	110 or 220 Volts A.C.	135.00
2795E.	500	32	15.0	1	110 or 220 Volts A.C.	135.00
2800E.	500	110	4.5	1	110 or 220 Volts A.C.	135.00
2805E.	500	230	2.2	1	110 or 220 Volts A.C.	135.00
2810E.	750	32	23.0	1-1/2	110 or 220 Volts A.C.	150.00
2815E.	750	110	6.8	1-1/2	110 or 220 Volts A.C.	150.00
2820E.	750	230	3.3	1-1/2	110 or 220 Volts A.C.	150.00

NOTE: Speed of all motors is 1725 R.P.M., and all operate on either 110 or 220 Volt A.C.—60 cycle circuits.

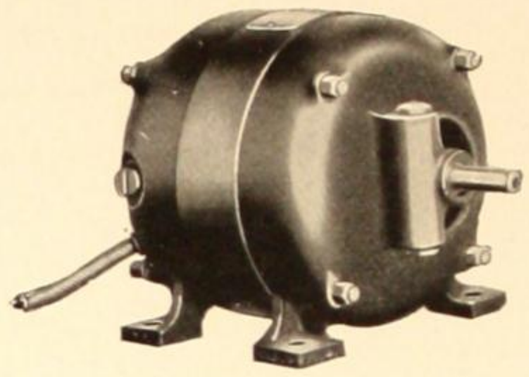
2825E. Motor-generator Sets with Switchboard. Consists of a motor-generator similar to those listed on the previous page, but with a control panel containing: Automatic cutout switch to prevent discharge of battery through generator, line switch, rheostat for reducing D.C. output from 24 to 6 volts, D.C. ammeter for reading charging current, and D.C. voltmeter for reading voltage of output circuit. These self-contained units are valuable for charging storage batteries (1-2-3 or 4 six-volt size in series) and for supplying current for regular laboratory use.

No.	A	B	C
Output, watts	150	300	500
Output, max. volts	24	24	24
Output, max. amps.	6.5	12.5	21
Motor, H.P. Rating	1/3	3/4	1
Motor will operate on	110 or 220 V. A.C., 60 cyc.	110 or 220 V. A.C., 60 cyc.	110 or 220 V. A.C., 60 cyc.
Motor speed, r.p.m.	1725	1725	1725
Each	**$130.00**	**165.00**	**190.00**

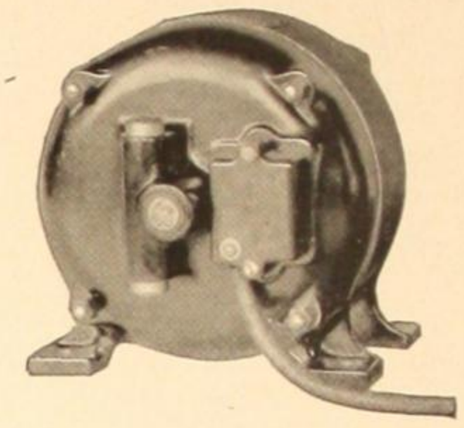
Fractional Horse Power Motors



No. 2830E.



No. 2860E.

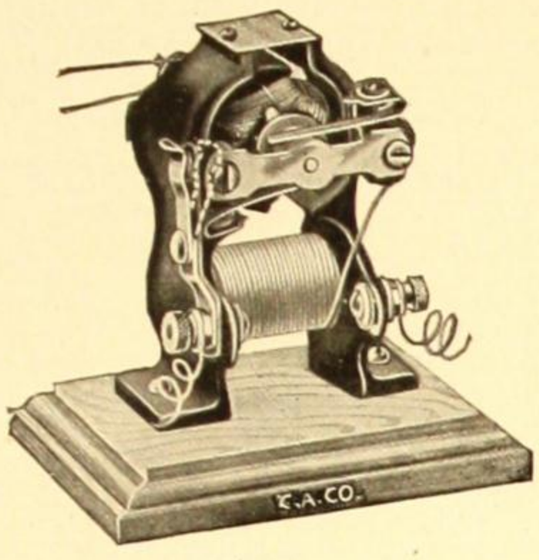


No. 2870E.

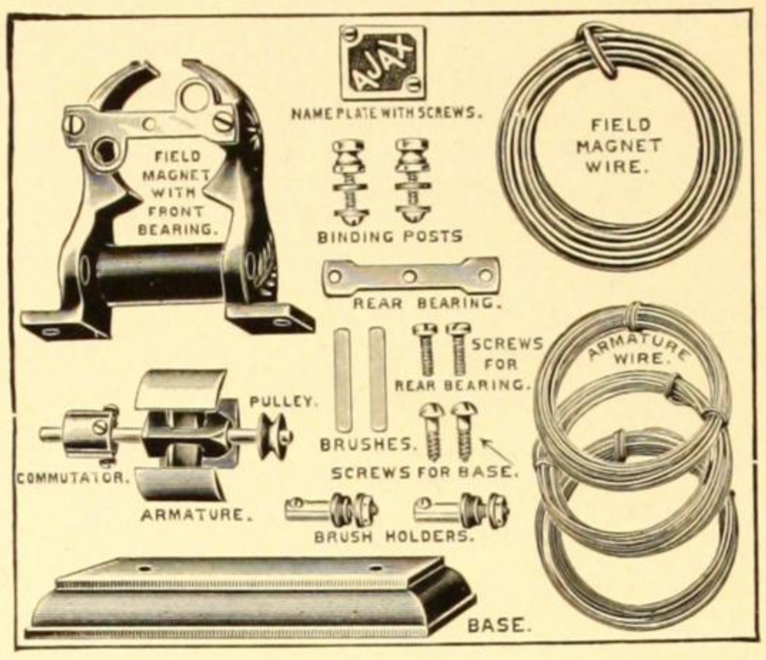
We list below a complete line of fractional horse power motors in sizes from 1/100 H.P. to 1/4 H.P. and in types suitable for operation on both 110-volt and 220-volt A.C. and D.C. circuits. Sizes from 1/100 H.P. to 1/20 H.P. are suitable for operating stirrers, shakers, revolving electrodes and other light work of an intermittent character. The larger sizes are of the constant duty type and excellent for operating blowers, vacuum pumps, grinders and numerous other like laboratory devices. All are of the finest manufacture and have refinements which adapt them particularly to laboratory service. Protective housing, excellent lubrication, terminals for easy installation, legs cast integral with the frames and provided with screw holes for mounting, and readily replaceable brushes are a few of the features in these motors which will be appreciated by laboratory workers. Available in sizes and specifications given below. Catalogue number and price only need be specified when ordering.

Cat. No.	Horse Power	Current	Volts	Cycles	Speed R.P.M.	Pulley Diam., Inches	For Round Belt, Diam., Inches	Flat Belt Width, Inches	Current Consumption, Amperes	Type*	Each
2830E.	1/100	A.C.	110	60	2200	5/8	1/8		0.36	S.W.	**$12.00**
2835E.	1/100	D.C.	110		2200	5/8	1/8		0.18	S.W.	**12.25**
2840E.	1/50	A.C.	110	60	1800	1 1/4	3/16		0.80	S.W.	**15.00**
2845E.	1/50	D.C.	110		1800	1 1/4	3/16		0.37	S.W.	**15.75**
2850E.	1/25	A.C.	110	60	1800	1 1/4	3/16		1.40	S.W.	**18.25**
2855E.	1/25	D.C.	110		1800	1 1/4	3/16		0.72	S.W.	**18.50**
2860E.	1/20	A.C.	110	60	1725	1 3/8	1/4		2.00	S.P.	**16.00**
2865E.	1/20	A.C.	220	60	1725	1 3/8	1/4		1.00	S.P.	**16.75**
2870E.	1/20	D.C.	110		1725	1 1/4	3/16		0.70	S.H.	**17.00**
2875E.	1/20	D.C.	220		1725	1 1/4	3/16		0.35	S.H.	**18.75**
2876E.	1/15	A.C.	110	60	1800	1 1/4	3/16		2.00	S.W.	**18.85**
2877E.	1/15	A.C.	220	60	1800	1 1/4	3/16		1.00	S.W.	**20.35**
2880E.	1/15	D.C.	110		1800	1 1/4	3/16		0.92	S.W.	**19.00**
2885E.	1/15	D.C.	220		1800	1 1/4	3/16		0.46	S.W.	**20.50**
2890E.	1/8	A.C.	110	60	1725	1 7/8	1/4		3.20	S.P.	**16.25**
2895E.	1/8	A.C.	220	60	1725	1 7/8	1/4		1.60	S.P.	**17.25**
2900E.	1/8	D.C.	115		1725	1 7/8	1/4		1.50	C.W.	**20.25**
2905E.	1/8	D.C.	230		1725	1 7/8	1/4		0.75	C.W.	**22.25**
2910E.	1/6	A.C.	110	60	1725	2 1/2		1 1/4	4.40	S.P.	**16.85**
2915E.	1/6	A.C.	220	60	1725	2 1/2		1 1/4	2.20	S.P.	**17.75**
2916E.	1/6	D.C.	115		1725	2 1/2		1 1/4	2.00	C.W.	**22.50**
2917E.	1/6	D.C.	230		1725	2 1/2		1 1/4	1.00	C.W.	**23.50**
2920E.	1/4	A.C.	110	60	1725	2 1/2		1 1/4	5.40	S.P.	**18.00**
2925E.	1/4	A.C.	220	60	1725	2 1/2		1 1/4	2.70	S.P.	**18.85**
2930E.	1/4	D.C.	115		1725	2 1/2		1 1/4	2.70	C.W.	**23.00**
2935E.	1/4	D.C.	230		1725	2 1/2		1 1/4	1.35	C.W.	**23.75**

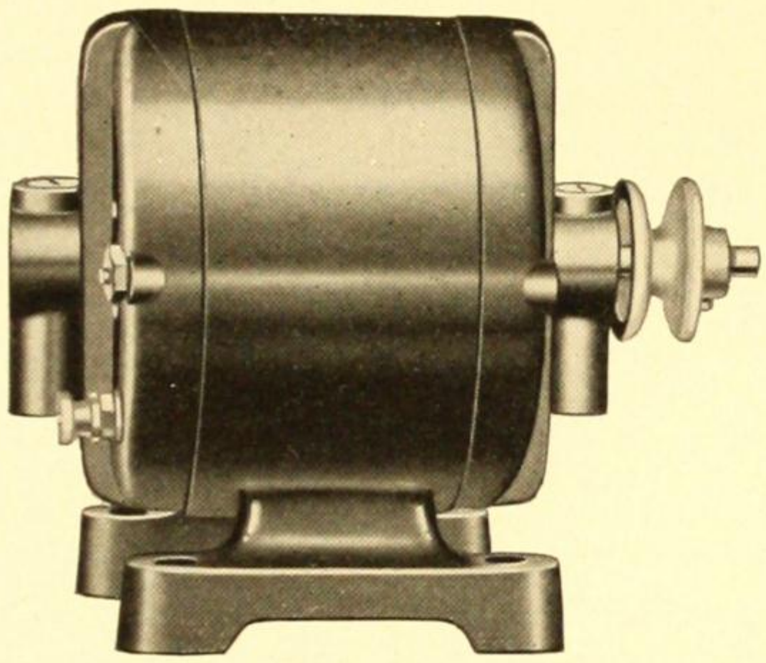
*NOTE: **S.W.** indicates Series Wound; **S.P.** indicates Split-phase, **a.c.** induction type for constant speed on continuous service; **S.H.** indicate shunt wound constant speed and continuous service type; **C.W.** indicates Compound Wound Constant Speed and continuous service type.



No. 743E.



No. 748E.



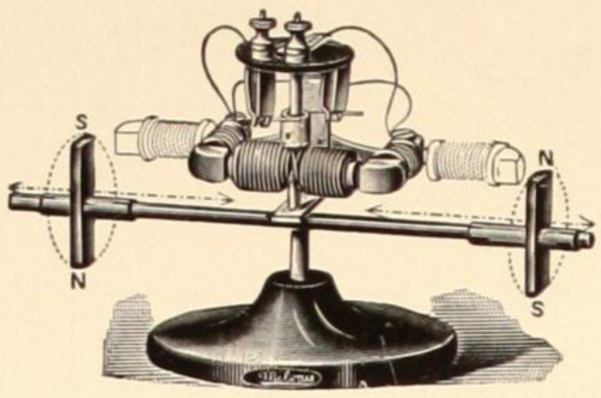
No. 755E.

743E. Motor, Little Hustler. Will run at high speed on one No. 113E Dry Cell or on a 110-volt A.C.Circuit through a No. 1033E Transformer. This motor is 3½ inches high, finished in black enamel, with nickel-plated trimmings. Has three-pole armature, causing the motor to start without assistance when the current is applied. The shaft, ⅛ inch in diameter, is fitted with a pulley for running toys, models, etc., and will drive No. 753E Fan at high speed....**$2.00**
Dynamo, Little Hustler, is listed on Page 55.

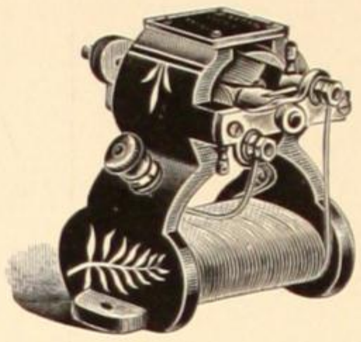
748E. Motor Parts, Little Hustler. These parts will enable the student to construct his own motor and thus demonstrate the principles he has learned. All parts ready to assemble into a finished motor like No. 743E. Explicit directions showing how to wind and assemble accompany each set.....**$2.00**

755E. Motor, A.C., 110 Volt. A low-priced power motor for general laboratory use. Operates on any 110-volt, 60-cycle alternating-current lighting circuit. Develops 1-25 horse power. Speed 3600 R.P.M. The construction follows standard commercial design for heavy duty and continuous service; Two-pole laminated field; eleven-slot laminated armature; eleven-segment, mica-insulated commutator; ¼x5⅞ inch shaft; 1-inch, V-grooved pulley for $\frac{3}{16}$ to ¼ inch round belting; wick-feed oil cups. Height 4½ inches, weight 4½ pounds.....**$12.00**

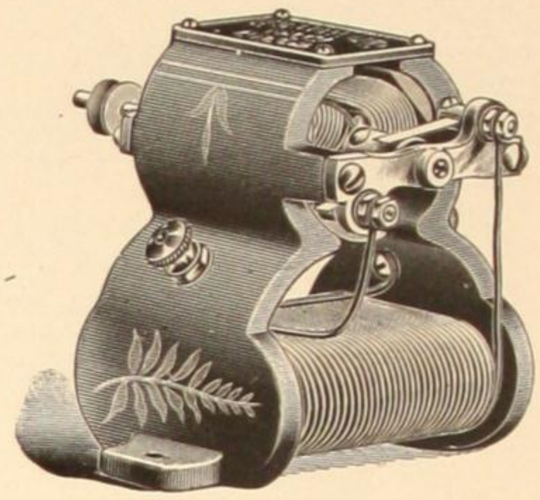
756E. Motor Parts, A.C., 110 Volt. These parts will enable the student to build a 1-25 H.P. A.C. motor exactly like No. 755E illustrated and described above, thus demonstrating the principles he has learned. Requires very little skill to wind and assemble, and when finished is a perfect working machine that will run on any 110-volt—60-cycle—alternating current lighting circuit. All castings are finished. Armature discs are assembled on the shaft. Commutator, brushes, wire, screws, pulley, and all other necessary parts are included. The assembly of this Set of Parts will give students the same insight into A.C. motor principles, design, and construction that the No. 748E Set of Parts has for so many years given in the case of the D.C. motor. Although only recently introduced these outfits have already been used successfully in the Physics and Electrical Departments of numerous schools. Complete directions come with each set.....**$9.50**



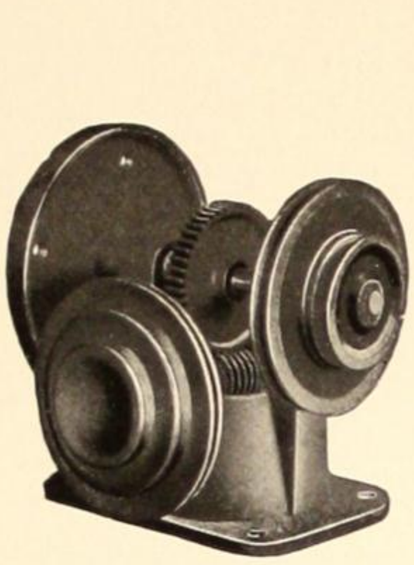
No. 758E.



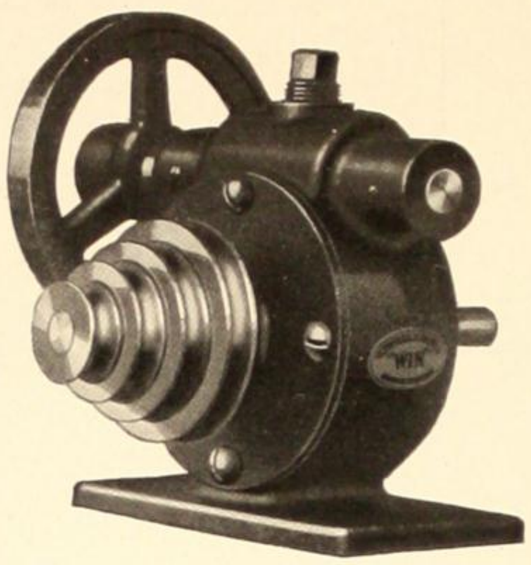
No. 763E.



No. 768E.



No. 770E.



No. 771E.

758E. Motor, Milvay. An improved form of St. Louis Motor for use in the study of motor and dynamo principles. The following points, which cannot be shown with an ordinary motor, can be shown to good advantage with the Milvay motor. The top, which carries the brushes, can be rotated to show the effect on the speed by changing the point of commutation. The permanent field magnets can be moved away from the armature to show the effect on speed by increasing and decreasing the gap between the field and armature. The same point can be shown with the electromagnetic field magnets. By connecting a rheostat (No. 918E) into the battery circuit the effect on the speed when the resistance is increased or decreased may be observed. By reversing the permanent field magnets the effect on direction of rotation may be shown. By moving the permanent field magnets out of the way and connecting the electromagnetic fields in parallel with the armature, the characteristics of a Shunt-wound motor may be studied. Connecting the electro-magnetic fields in series with the armature, the characteristics of the Series-wound motor may be observed. Swinging the electromagnetic fields out of the way, moving the permanent magnets back into place, and connecting a galvanometer (No. 523E) to the binding post terminals, in place of the dry cell, the characteristics of a dynamo may be studied. Every part is easily accessible and always completely visible. This makes it easy to test the polarity of either end of the armature core, as well as of the field magnets. Runs at high speed on one dry cell or other battery. Complete with both permanent magnets, electromagnets and full directions **$5.00**

763E. Motor, Standard, No. 1. This motor is designed to run on a single cell, although two may be used if desired. If two are used, they should be connected in series. The motor develops sufficient power to propel mechanical toys, models and other similar devices. Finished in black enamel, nickel-plated trimmings. Weighs about 1½ pounds; occupies a space 3½ inches square. Speed, with average load, about 2,200 R.P.M..... **$4.25**

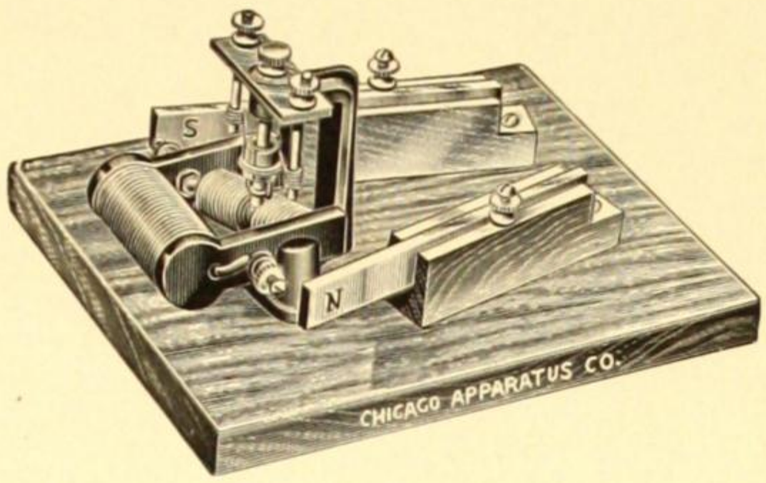
768E. Motor, Standard, No. 2. Similar to No. 763E, but larger and heavier with corresponding increase in efficiency. Designed to operate on a two or three cell battery. Finished in black enamel, brass trimmings. Weighs about 2¾ pounds; occupies space about 4 inches square. Runs at about 2,800 R.P.M. with average load on a current of 2 amperes, 4 volts **$7.25**

769E. Countershaft. For screwing to table, bench, baseboard, or other flat surface. Shaft, 12x¼ inches, is mounted in two end bearings and is parallel and about 3 inches above the base. On this shaft are 4-grooved pulleys—1, 2, 3 and 4 inches in diameter. These pulleys may be shifted along the shaft to any desired position and are held in place by set screws. Used in belting small motors and engines to other machinery **$3.25**

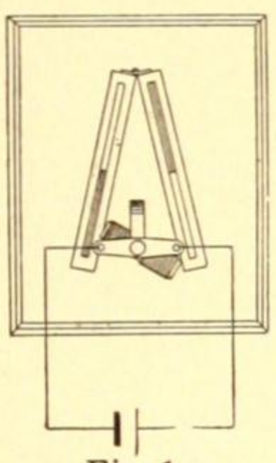
770E. Speed Reducing Gear. For converting the high speed of motors into a slow, powerful motion. The round plate (shown at the left in illustration) may be removed if desired, and direct connection made to shaft. This round plate is provided with screw holes for attaching a large wooden disk used for display and other purposes. Diameters of (front) driving pulley—2, 3 and 4 inches. Diameters of (side) driven pulley—2 and 4 inches. Both are grooved for $\frac{3}{16}$ or ¼-inch round belt. Worm and gear mechanism have a reduction ratio of 48 to 1, that is the 3 grooved pulley will make 48 revolutions, while the 2 grooved pulley makes one. Base has four screw holes. The action of this gear is not reversible; it can only be operated (in either direction) by applying power to the 3-groove drive pulley.... **$9.00**

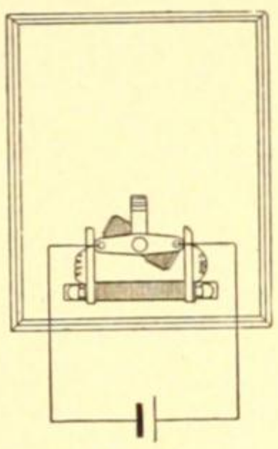
771E. Speed Reducing Gear. In this device the worm and gear mechanism are enclosed in a case filled with grease. As a result all bearings are self-lubricating. Runs silently and requires little attention. Diameter of (back) driving pulley, 4 inches. Diameter of (front) driven pulley, 1, 1½, 2 and 2½ inches. Worm and gear mechanism have a reduction ratio of 48 to 1, that is the single-grooved drive pulley will make 48 revolutions while the 4-grooved pulley makes one. Both are grooved for $\frac{3}{16}$ or ¼-inch round belt. Base has four screw holes. The action of this gear is not reversible; it can only be operated (in either direction) by applying power to the single-grooved drive wheel..... **$14.00**

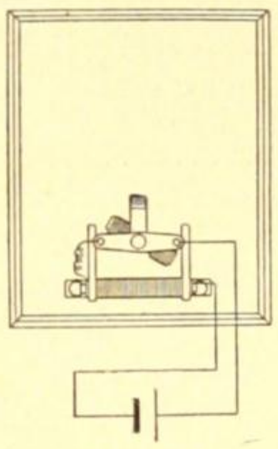
Milvay St. Louis Motor



Nos. 773E-774E.


Fig. 1.


Fig. 2.


Fig. 3.

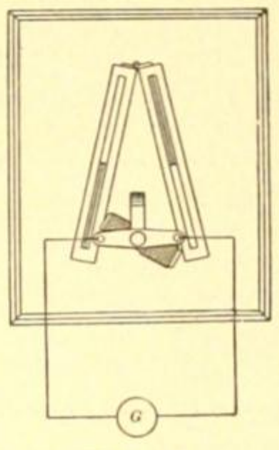


Fig. 4.

773E. Motor, St. Louis. Every part is easily accessible and always completely visible. This makes it easy to test the polarity of either end of the armature core —something which cannot be done in an ordinary motor.

Runs at high speed on one dry cell.

The top which carries the brushes can be rotated to show the effect on the speed by changing the point of commutation.

The permanent field magnets can be swung away from the armature to show how the speed is affected by changing the gap between the fields and the armature.

By connecting a rheostat (No. 918E) in series in the battery circuit the effect on the speed when resistance is increased or decreased may be observed.

By reversing the permanent field magnets end for end the effect on direction of rotation may be shown.

By swinging the permanent field magnet out of the way and connecting the electromagnet (No. 774E) in parallel with the armature as in Fig. 2, the characteristics of a Shunt-wound motor may be studied.

Connecting the electromagnet in series with armature and cell as in Fig. 3, the characteristics of the Series-wound motor may be observed.

Removing the electromagnet, swinging the permanent magnets into place, and connecting a galvanometer (No. 523E) as in Fig. 4, the characteristics of a dynamo may be studied.

This model was suggested by the physics teachers of St. Louis and it has deservedly gained wide popularity. In many schools a sufficient number have been installed for individual student use.

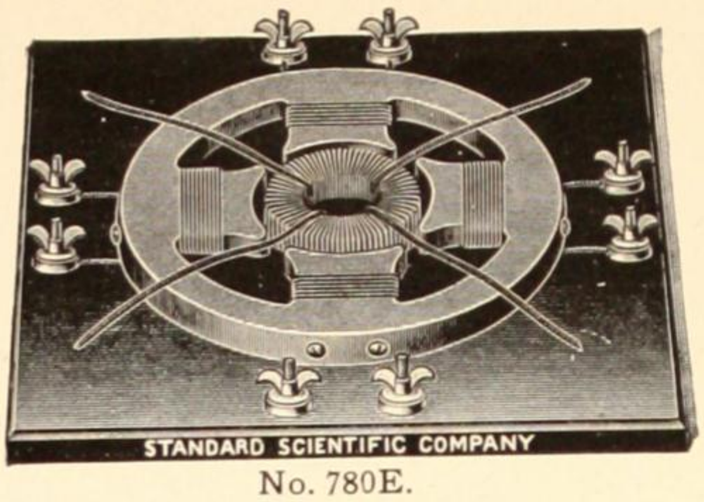
With two 6-inch permanent field magnets (bar magnets), on 8x10 inch mahoganized hardwood base **$3.50**

774E. Electromagnet. For use with above motor in the study of Shunt-wound and Series-wound motors **$1.00**

776E. A.C. Armature. For use with No. 773E St. Louis Motor in the study of alternating currents **$1.00**

918E. Rheostat. Sliding lever type, 0 to 10 ohms, round pattern, two binding posts, for regulating speed of above motor. (For further description see **Rheostats** in this section) **$1.75**

523E. D'Arsonval Galvanometer. For use with above motor in the study of the dynamo. (For description and illustration see **Galvanometers** in this section) **$6.75**

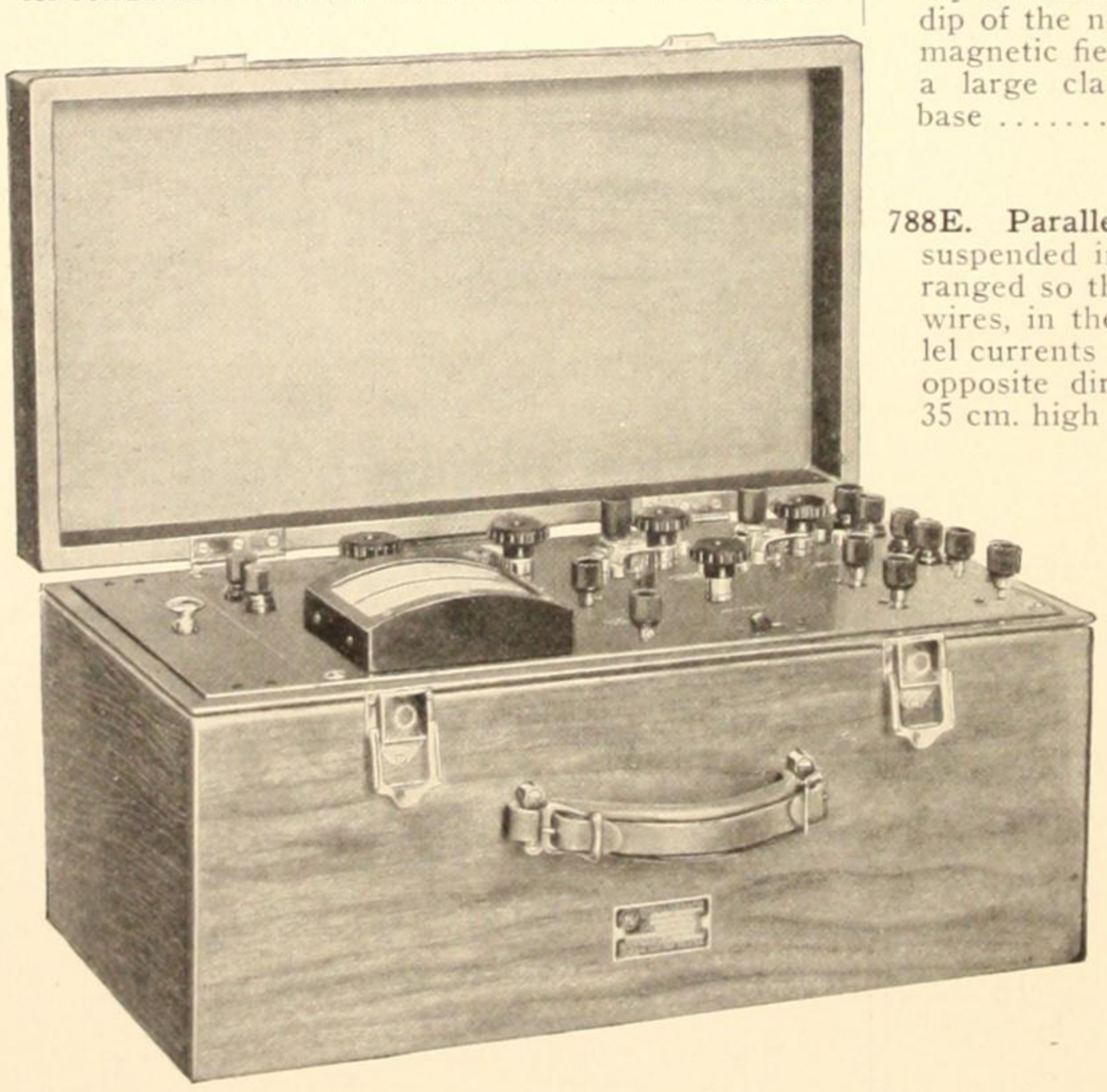


No. 780E.

780E. **Motor-Dynamo Demonstration Outfit, Four-Pole Type, Stansico-Pratt.** Represents a section of an actual motor of the latest four-pole type. The yolk with four pole pieces attached is securely bolted to a 10x10 in. insulated base. The terminals of the field coils are brought out to eight binding posts. The armature is movable and its windings terminate in four long flexible leads. The flat sectional design makes it easy to plot the lines of force by the compass or filings method. Complete with movable armature $10.00

781E. **Glass Plate.** 12 in. square, to fit over No. 780E. Useful in plotting the lines of force by the filings method $0.75

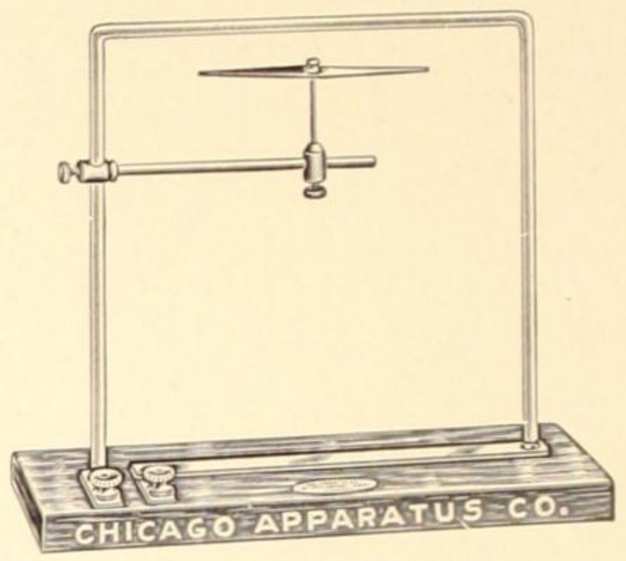
782E. **Oersted's Law Apparatus.** For the study of the magnetic action of currents and formulating Ampere's rule (right hand rule). Consists of a 10x30 cm. wood base on which two parallel conductors with binding posts are mounted; and a sensitive 15 cm. magnetic needle pivoted midway between the parallel conductors $3.50



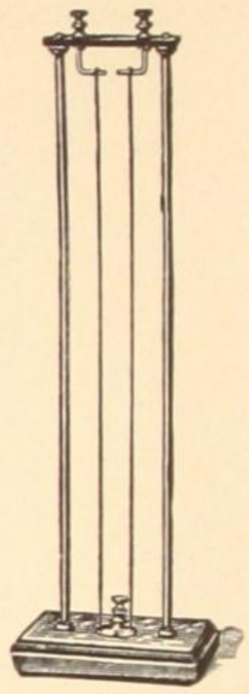
No. 785E.



No. 782E.



No. 783E.



No. 788E.

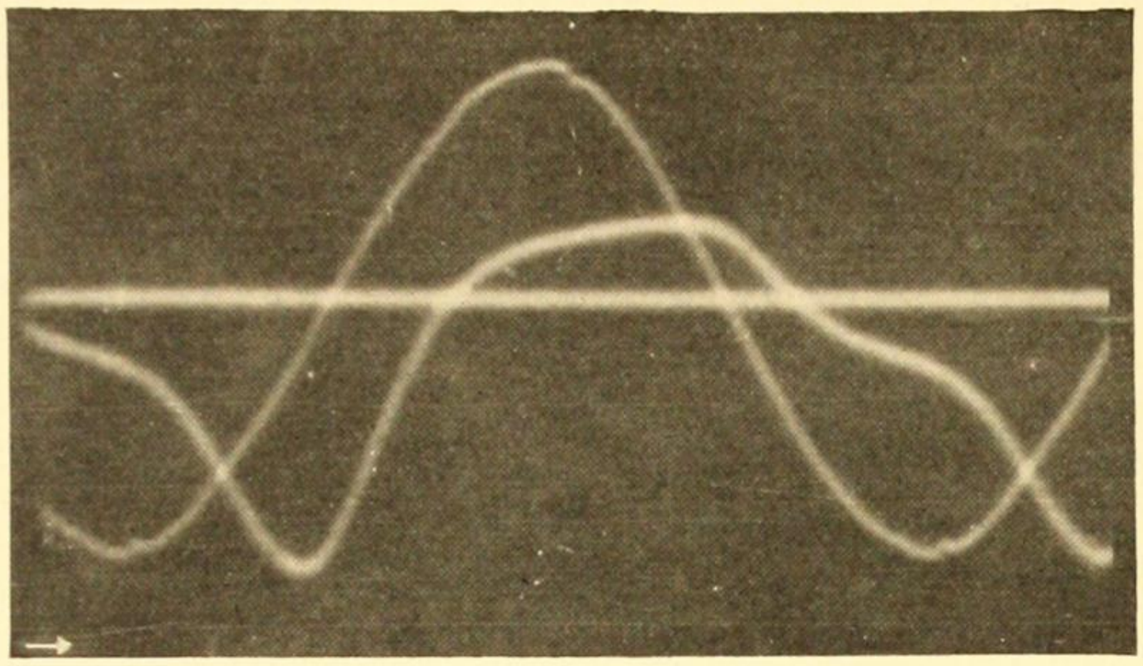
783E. **Oersted's Law Apparatus.** A 15 cm. magnetic needle is pivoted on an adjustable support so that it can be placed parallel to and above, below or on either side of the horizontal wire, and with either its north pole or its south pole close to and on any side of the vertical wire. The current from a single dry cell is sufficient to show a marked deflection or dip of the needle, thus enabling the direction of the magnetic field about a wire to be mapped out before a large class. Mounted on 10x30 cm. hardwood base $3.50

788E. **Parallel Current Apparatus.** Two copper wires suspended in a special stand with binding posts arranged so that currents may be made to flow in the wires, in the same or in opposite directions. Parallel currents in the same direction cause repulsion; in opposite directions attraction. Apparatus is about 35 cm. high $3.50

OSCILLOGRAPH

785E. **Oscillograph, New Two-Element Type.** For showing visually or recording photographically the wave-form of an electric current or impulse and for the precision timing of short intervals. For many purposes of investigation or analysis, the oscillograph has become an indispensable instrument in physical, engineering, and other laboratories. It may be used to investigate transients such as the variations of currents and voltages during the short-circuit of an alter-

Oscillograph—Cont.



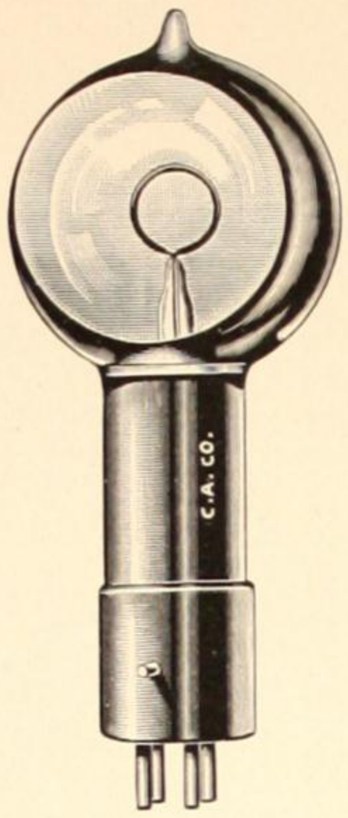
No. 785E.

nator, transformer primary, or motor field winding, etc.; to study the performance of short circuit breakers;. the current and voltage relations during the blowing of a fuse; the current and voltage relations during the discharge of a condenser; the current and voltage relations during the interruption of a spark-coil primary, etc.

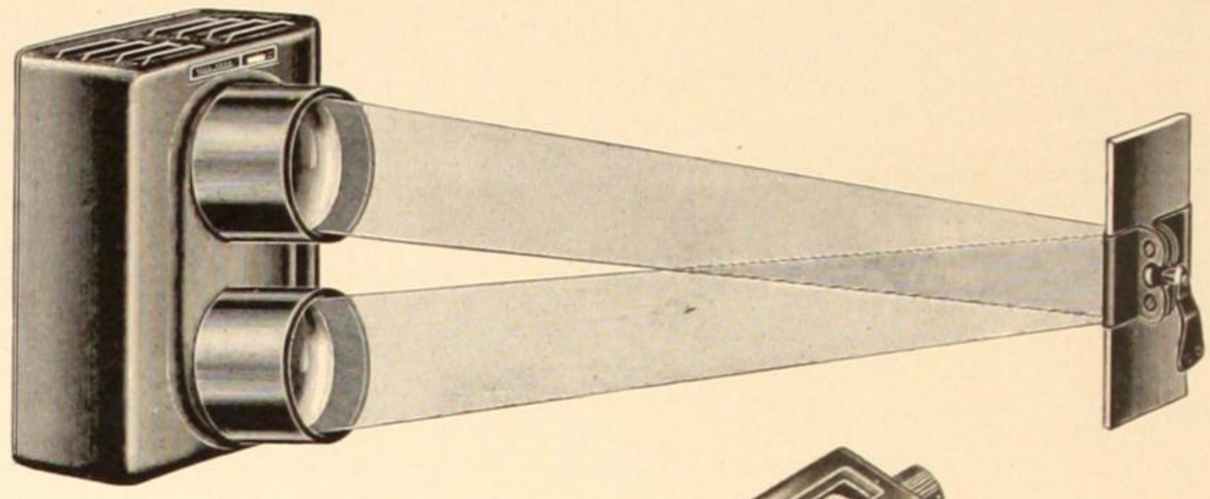
Since the oscillograph shows visually what is going on in electric circuits of all kinds, the motion of things that move can be investigated by causing their movements to affect the flow of a current. Thus heart beats, explosions, vibration in materials, etc., can be investigated. Wherever there is a phenomenon that varies rapidly with time, an oscillograph can be made applicable to its study. Thus, in this new oscillograph one element may be made to reveal the "make and break" curve of a spark-coil primary, the time period of which can be measured against the known time period of a 60-cycle curve traced by the second element, since both curves appear side by side in the viewing screen or on the photographic record. Similarly, other recurrent phenomena can be timed with great precision against other cyclic curves of known frequency.

The elements are of the permanent-magnet type. A single metallic filament is stretched down and back again in a small intense field produced by a powerful permanent magnet. When a current flows through this filament, its direction in the two portions is in opposite directions. Hence the two portions of the filament move in opposite directions. This causes a small mirror cemented across the two sections of the filament to deflect. This deflection is indicated by a beam of light reflected from the mirror. If a photographic record is desired, the reflected beam of light is allowed to strike a moving photographic film. If a visual examination is desired, the reflected beam of light first strikes the rotating mirror and thence the viewing screen. Since the natural frequency of the vibrator is approximately 10,000 v.p.s., the elements can follow alternations of electric currents within the audio frequency range.

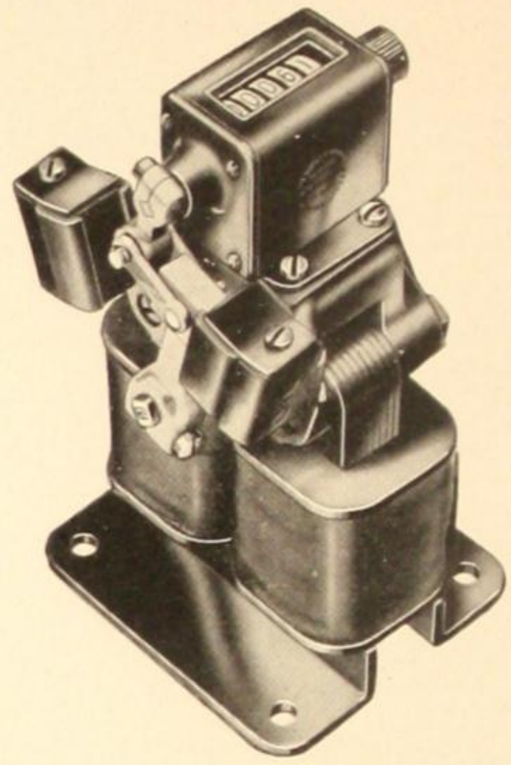
The two-elements, single phase motor, optical system, etc., are mounted on the underside of a stout insulating panel with all necessary controls conveniently placed above. The whole is mounted in a fine wood carrying case with handle. The cover, provided with slip-off hinges can be readily removed to form a hollow supporting base when the instrument is to be used in a vertical position for lecture work. The instrument is designed for operation from any 110-volt A.C. circuit. Unlike older types, this new portable model is so simple in operation that anyone can use it. Including one film holder and viewing screen **$950.00**



No. 2940E.



No. 2946E.



No. 2948E.

2940E. Photoelectric Cell, 2-inch Bulb. This cell is especially suitable for general laboratory work—experimental, research, and demonstration—with television, talking movie, telephotography, photometry, illumination control, alarm, color, counting, timing, and optical relay circuits. Its chief characteristics are: High sensitivity, instantaneous action, low dark current, long life, and responsiveness to small changes of light intensity and color. The tube base has four prongs, two for the purpose of mechanical support only. Fits any receptacle designed for four-prong radio tube of the X-class **$17.50**

2941E. Receptacle. For mounting No. 2940E. A standard receptacle for four-prong tubes. Its construction insures excellent contacts and good mechanical support for the cell. Size about 2x2 inches **$0.35**

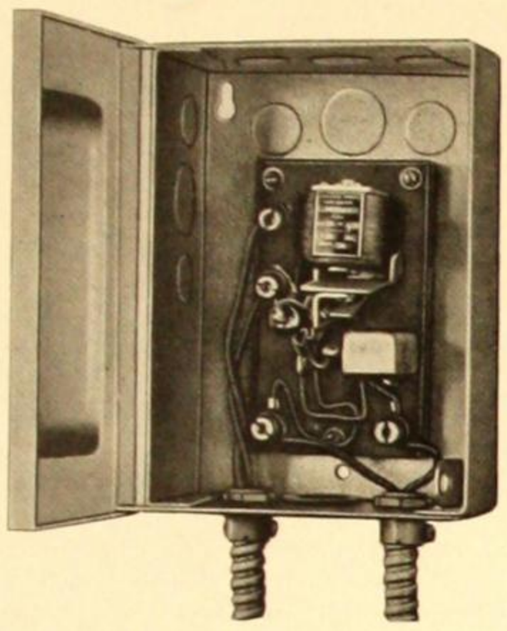
2946E. Photoelectric Relay and Light Source Combined. A complete electrically operated switch with beam of light control. Any interception of the beam of light by an object passing between the lens and mirror causes the relay contact to close. It is therefore possible to operate signals, counters, power switches, and practically any other sort of an electrical device by the medium of light. Consists of a lamp, photoelectric cell, amplifier, tube, and all other electrical components mounted in a metal case. The light from the small lamp is focused by means of the upper lens upon a remotely placed mirror from which it is reflected to the lower lens in the case. The photoelectric cell receives the light collected by the lower lens. A few of its many practical uses are: Optical counting, automatic control of illuminants, testing of rotating devices, operation of trespass signals, operation of camera or signals at finish line in races, controlling marking devices on chronographs or automatic recording instruments, frictionless timing or control of apparatus from pendulums or pendulum clocks, controlling switches at high speed; starting, stopping and reversing motors and machines.

To operate, the unit is connected to a 110-volt, 60 cycle lighting circuit by means of the cord and plug supplied. A second cord which is also supplied is connected to the relay contacts for operating a lamp, counter, power switch, etc. The mirror placed at a distance of 2 to 30 feet is adjusted until the beam of light from the upper lens is reflected upon the lower lens. Final adjustment is made by turning a recessed screw on the front of the case until the relay clicks when the light is interrupted with the hand. This adjustment takes but a few seconds. The contacts of the relay are connected within the case to the 110-volt, 60 cycle line. The relay cord will therefore operate 110-volt, 60 cycle lamps, counters, and mercury switches. The relay contacts can be wired without 110-volt, 60-cycle power supply so that devices operating on circuits other than 110-volt, 60 cycle, may be operated from the relay contacts in series with the required current source.

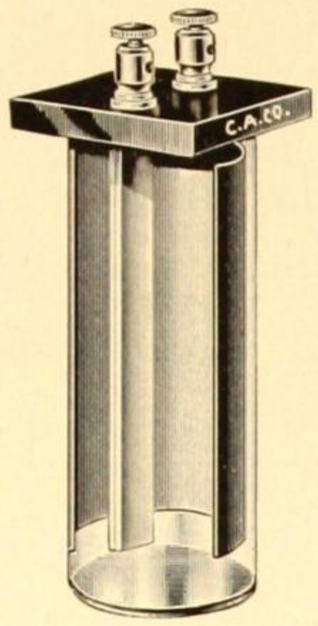
This unit will respond up to 1200 interruptions per minute. When devices to be operated from the relay contacts draw in excess of 60 watts, the No. 2952E Power Switch listed on page 115 should be used. Complete unit, with photoelectric cell, amplifier, light bulb, mirror with bracket and two cords. For use on 110 to 115-volt, 60 cycle A.C. circuits only..... **$65.00**

2948E. Magnetic Counter. For use in the relay contact circuit of No. 2946E Unit or other 110-volt, 60 cycle circuits. Very positive in its action, does not chatter, and will count up to 250 light variations per minute. It has five wheels, counting to 99,999. One turn of the reset knob returns all wheels to zero. A condenser of proper size is provided across the counter coil to prevent arcing of the relay contacts **$27.50**

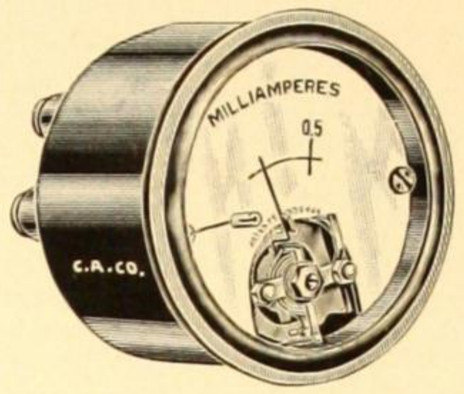
2949E. Magnetic Counter. Same as No. 2948E, but wound for use on 6-volt D.C. circuits. An excellent electrically operated counter suitable for many laboratory purposes **$25.00**



No. 2952E.



No. 2956E.



No. 2957E.

2952E. Mercury Contact Power Switch. For use in the relay contact circuit of No. 2946E Unit for opening and closing the power supply line to electrical devices having heavy current draw and to be controlled by the beam of light method. The local circuit of the switch is an evacuated mercury contact tube capable of opening or closing a non-inductive circuit of 20 amperes at 110 volts or 10 amperes at 220 volts. This switch is so wired that any interruption of the beam of light from No. 2946E Unit will close the circuit in which the apparatus to be controlled is placed. Thus, it starts devices when the beam is interrupted. Maximum operating speed, about 60 variations per minute.....**$20.00**

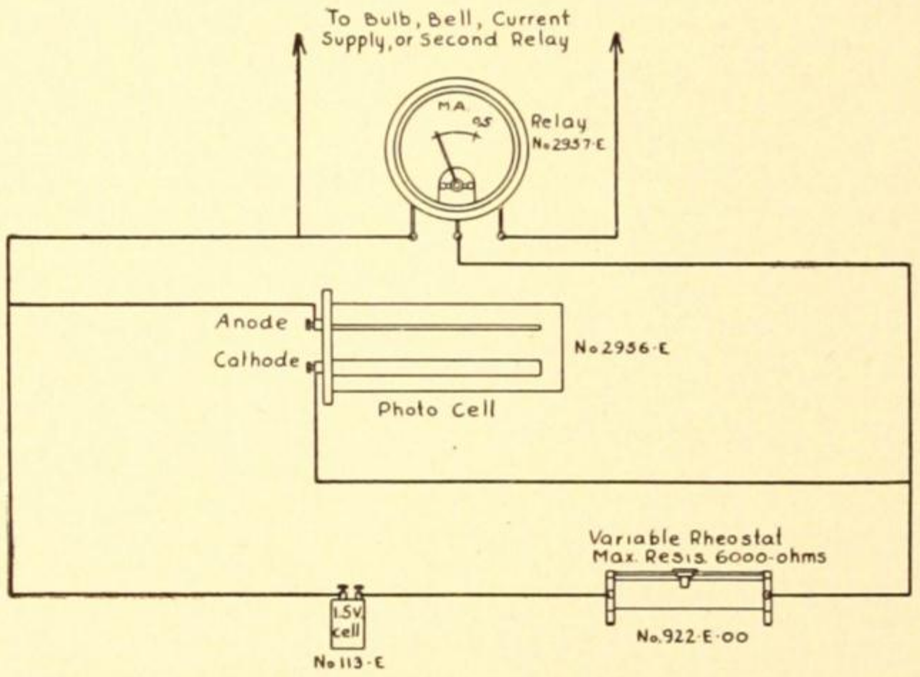
2953E. Mercury Contact Power Switch. Same as No. 2952E, but wired to open (instead of closing) the secondary circuit in which the apparatus to be controlled is placed. This type stops devices when the beam is interrupted **$20.00**

2956E. Photoelectric Cell, Liquid-Type. (Patented.) A new light-sensitive cell that generates its own current, about one milliampere, when exposed to direct or reflected sunlight, or other strong light. It will operate No. 2957E Relay, when the same is placed in a circuit through which a current of about 0.4 milliamperes is made to flow, the additional current necessary to properly close the relay contacts being supplied by this photoelectric cell, when a beam of light is made to fall upon its cathode.

The light bulb, bell, electric counter, or other device which it is desired to control, by directing a light beam upon the cell, together with the current supply necessary to operate the device, must be placed in series with the relay contacts. These contacts, in a sensitive relay like our No. 2957E, must necessarily be quite small, thus making their carrying capacity likewise quite small. Hence, only devices having a low current draw—about 2 watts—can be safely operated in the circuit which they make and break.

However, by placing a polarized relay like our No. 955E in this circuit; with the light or bell, and the current supply connected to the contacts of this second relay, more powerful devices can be operated. By placing colored glass plates, colored solutions, turbid water, smoke, etc., in the path of the light beam their effects upon the action of the cell can be shown. Likewise, the reflecting power of various surfaces can be demonstrated. In fact the applications are almost endless, being limited only by the resourcefulness of the operator.

The cell consists of a liquid-filled glass jar with sealed-on bakelite top to which the cylindrical-concave, light-sensitized cathode and slender rod-shaped anode are attached, both being provided with suitable external binding post terminals. Overall height, 12.5 cm. **$10.00**



Wiring Diagram for No. 2956E Photo-electric Cell and Accessories.

2957E. Sensitive Galvanometer Relay. This little instrument contains a moving coil not unlike that in portable galvanometers. A current of 0.5 milliamperes produces full deflection, closing a pair of contact points brought out to binding post terminals at the back of the instrument. One of these posts and a third constitute the terminals for the moving coil. Especially designed for use with No. 2956E Liquid-Type Photoelectric Cell described above. Diameter, 58 mm. **$12.50**

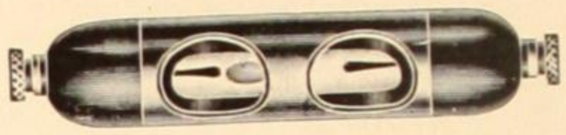
922E. Rheostat, Variable. (No. 00.) For regulating the dry cell circuit employed in connection with No. 2956E Photoelectric Cell. Maximum resistance, approximately 6140 ohms. At 1.5 volts, with the full resistance of this rheostat in circuit, the current flow is about 0.24 milliamperes.....**$8.00**

2960E. Polarity Indicator. Consists of two electrodes sealed into a glass tube filled with a chemical solution. When connected into a circuit the solution about the positive electrode turns red while that about the negative remains uncolored. Useful in determining the polarity of circuit terminals and the direction of current flow. Mounted in protective housing. For use on D.C. circuits up to 50 volts. **$3.00**

2965E. Polarity Indicator. Same as No. 2960E, but for use on D.C. circuits from 50 to 600 volts.... **$3.00**

2966E. Pole Indicating Paper. Negative pole shows red stain where two terminals are placed close together on a piece of this paper, moistened. Book of 25 (7x1 cm.) strips..... **$0.15**

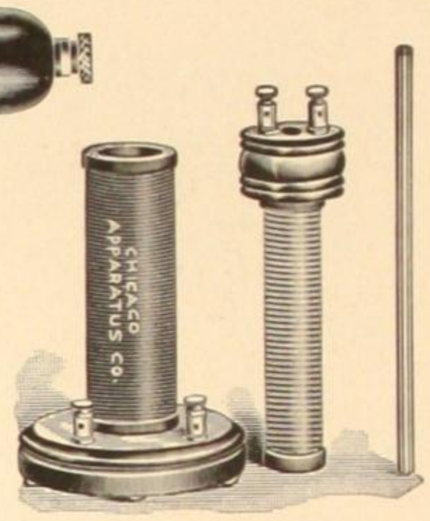
793E. Primary and Secondary Coil. For the study of current induction. The large number of windings on the secondary insures positive results. Mounted on two hardwood spools, the outer one provided with a base, the inner one removable. The inner spool (primary) is wound with a few turns of coarse wire, the outer (secondary) with many turns of fine wire. Each coil is provided with suitable binding posts. Total height about 20 cm. Complete with soft iron core **$4.25**



Nos. 2960E-2965E.



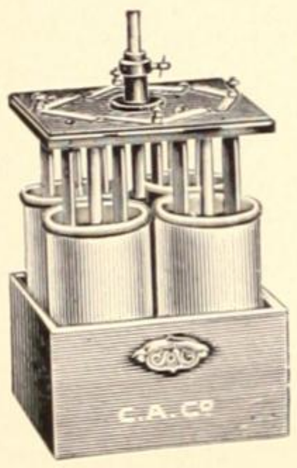
No. 808E.



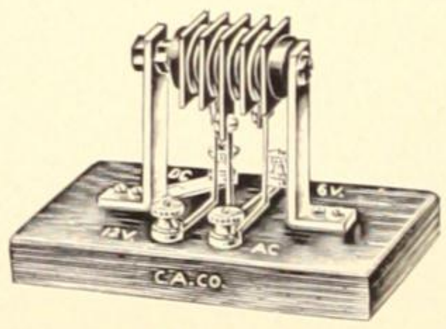
No. 793E.

808E. Push Button, Wood. Regular size, with screw top, diameter 55 mm. **$0.15**

Rectifiers — Battery Chargers



No. 818E.



No. 815E.

818E. Rectifier, Electrolytic (Nodon Valve). For use on 110 or 220 volt A.C. circuits to give a unidirectional current adapted to the needs of certain laboratory work—electrolysis, electroplating, charging of storage cells, etc. The action of this rectifier is due to the fact that an electric current will not enter an electrolyte from an aluminum electrode, but will do so freely from a lead electrode. The electrodes—eight 7x25 cm. lead plates and four 2x25 cm. aluminum rods—are attached to a substantial non-conducting top. The top connections are metal bars provided with binding posts for connecting into the A.C. line and for tapping off the D.C. current. The 75 cm. support rod in the center is for supporting the electrodes when raised out of the solution, in which position it is advisable to keep them when not in use. Small currents—5 to 10 amperes—may be drawn from this rectifier for hours at a time; large currents for proportionately shorter periods. Complete with hardwood box, 75 cm. support rod, four jars, chemicals, and full directions..... **$25.00**

819E. Chemicals for No. 818E.
Per complete charge $0.50

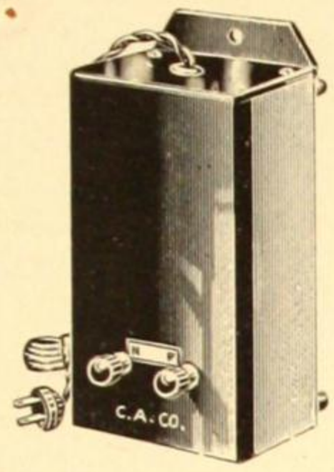
815E. Rectifier Unit, Dry Plate Type. Because of its many advantages—compactness, ruggedness, non-breakability and adaptability—dry plate rectifier units are extensively employed in the operation of dynamic speakers, railroad signaling devices, electric time clocks, battery chargers, radio power packs, etc. Being a concealed, built-in part which operates smoothly and silently, its presence is seldom realized and its function little appreciated.

To afford schools an opportunity to study and test the performance of this marvelous device we offer a full-wave standard commercial unit suitably mounted and provided with convenient terminals.

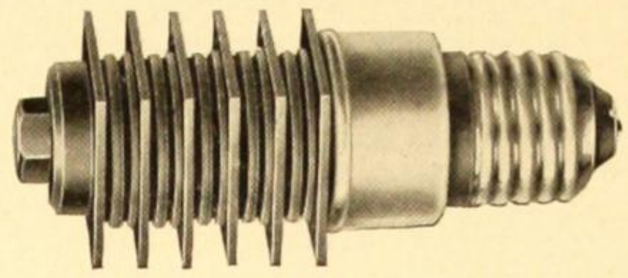
In use, an A.C. current of 9 to 12 volts is impressed on the A. C. terminals. The resulting E. M. F. at the D. C. terminals varies from 6 to 7.5 volts and the output from 0.25 to 2 amperes. This D.C. output may be used to operate bells, small motors, lamps, electromagnets, etc. It is also excellent for charging 6-volt storage batteries. Our No. 1033E or 1034E transformer is an excellent source of low voltage A. C. current for operating this rectifier unit.

By varying the A. C. input voltage and the D. C. current draw and employing meters in both circuits data can be secured which when plotted will accurately reveal the performance characteristics of the unit. Such a performance test is bound to prove interesting and profitable to students in electrical and radio courses.

Mounted on 10x15 cm. hardwood base with plainly marked terminals as illustrated..... **$6.50**



No. 822E.



No. 825E.

822E. Rectifier, New Dry Plate Type. Provides a dependable source of rectified current (6 volts, 2 amperes) from any 110-volt A. C. outlet. In the laboratory this rectified current can be put to many uses, such as: storage battery charging (6-volt), electrolysis, electroplating, energizing electromagnets, operating small motors, quantitative analysis of alloys and in the study of radio tube characteristics and the wave shape and form factor of rectified currents.

In operation the rectifier is dependable, noiseless and efficient. It is a full-wave rectifier, that is, it rectifies both halves of the A. C. current wave. As a battery charger, the charge rate tapers off as the battery takes its charge so that no damage will occur to either battery or charger from long continued use. In fact, it may be used to float across a battery to maintain it in full charge condition.

Normal output, 6 volts and 2 amperes. Inclosed in attractively finished metal housing, 6½x3½x2¾ inches. Provided with rubber feet to protect table tops against scratching. Hole in back extension plate permits the hanging of the rectifier against a wall or side of a cabinet. The output posts are conveniently located in front at the lower end of the case and the polarity of each is plainly indicated. Complete with cord and plug **$9.50**

824E. Rectifier, New Dry Plate Type, 6-ampere size. Same as No. 822E, but larger. Normal output, 6 volts and 6 amperes. Will charge storage batteries more rapidly; will decompose water in electrolysis apparatus faster; will energize larger electromagnets, developing greater lifting power; will operate larger motors, etc. For operation from any 110-volt A.C. outlet. Overall size, 6½x10½x2¾ inches. Weight, 13 lb. Complete with cord and plug.. **$25.50**

825E. Tungar Replacement Unit, Dry Plate Type. For replacing the glass bulb in battery chargers or rectifiers having a two ampere charging rate. With Edison screw base and top connecting pin. These are single-wave units that will give a life-time of silent, dependable service..... **$4.00**

829E. Tungar Renewal Bulb, Five Ampere. For bulb-type battery charger having a 5-ampere charging rate. For use on 110-volt, 60-cycle circuits. (Dry plate renewals for 5-ampere chargers are not available) **$8.00**



No. 828E.



No. 830E.

828E. Resistance Board, Milvay. As used in Millikan, Gale and Bishop's Course. For showing the relation of length, diameter, material and method of connection to the resistance of an electrical conductor. Four 100 cm. lengths of wire—one each bare German silver wire No. 24 and 30, bare iron wire No. 30, and bare copper wire No. 30—mounted on finely finished 14x120 cm. wood base, with eight large binding posts **$4.00**

830E. Resistance Board, Fuller and Brownlee's. For use in Laws of Resistance determinations (Exp. No. 73) as outlined in "Laboratory Exercises in Physics," by Fuller and Brownlee. Five binding post terminals are provided so that the potential drop over and current flow through 2 meters of No. 28 copper wire, 4 meters of No. 28 copper wire, 2 meters of No. 22 wire and 4 meters No. 28 wire can be most conveniently measured by the ammeter-voltmeter method. Wires and terminals are mounted on a finely finished hardwood 105x12.5 cm. board..... **$4.50**

831E. Resistance Board, Laws of. For convenience in connecting test wires, dry cell, and voltmeter into the circuit used for determining the relationship between the resistance of a wire and its length, cross-sectional area, and material. See Exp. 64, "Laboratory Exercises in Physics," by Fuller, Brownlee and Baker. Three double Fahnestock binding posts on hardwood board **$1.50**



No. 791E.

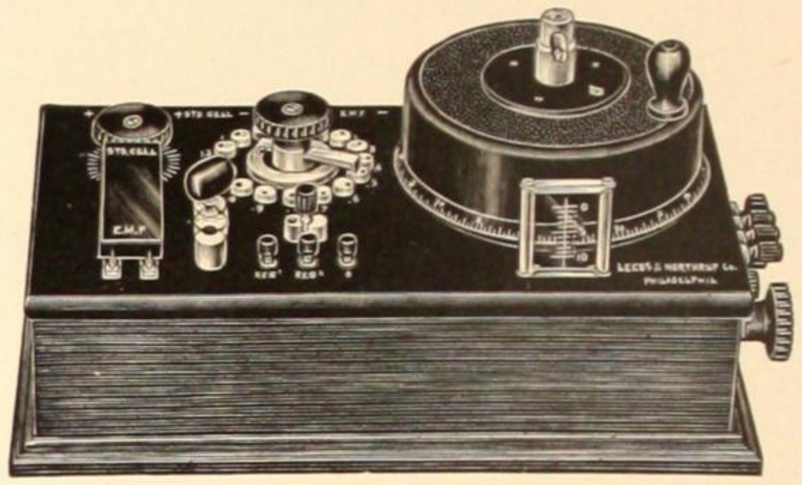
791E. Potentiometer, Pye's. For determining the electro-motive force of several galvanic cells, singly and in combination, by the potentiometer method as described in "Manual of Experiments in General Physics," by William F. Schulz, Ph.D., Assistant Professor of Physics, University of Illinois. Consists of a uniform high resistance wire 10 meters long, drawn back and forth for convenience sake, in ten lengths of 1 meter each, on a board supplied with a millimeter scale. This scale enables lengths of wire from either end of the loop to be measured directly. The contact key is carried by a sliding bridge, so that contact may be made at any point on any one of the ten lengths of wire. The key positions on the bridge are numbered to correspond with the wire with which the key makes contact. Suitable binding posts are provided for connecting galvanometer and batteries into circuit. Material and workmanship strictly high grade $25.00

2970E. Potentiometer, Precision Form, Type K., L. & N. For measuring potential difference by balancing the unknown potential difference against a known voltage drop. The advantages of this method are its extreme precision and also the fact that when the condition of balance is obtained, no current is being taken from the source of e.m.f. being measured. While its direct reading range is up to 16.1 volts, this can be extended to 300 volts or 750 volts by the use of suitable resistances or the volt boxes listed elsewhere in this section.

It is obvious that if a drop within the direct reading range over a definite fraction of a known resistance connected to the unknown e.m.f. can be measured, the drop over the entire resistance is instantly known. Thus, if the drop over 200 ohms measures 1.5374 and this constitutes the 1/100 part (of 20,000 ohms) of the total resistance across the unknown e.m.f., the value of the unknown e.m.f. would be 153.74 volts. This is the method employed in calibrating and testing voltmeters. Current flow can also be measured with a potentiometer by measuring the voltage drop across a known resistance, i.e., a standard resistance adjusted to a definite value. It is evident that when the voltage drop and the resistance are both known, the current flow can then be calculated from Ohm's law. Thus, if the voltage drop is .1545 volts over a standard resistance of 1 ohm, the current flow is 15.45 amperes. This is the method employed in calibrating and testing ammeters.

The above examples indicate the usefulness of this instrument in electrical measurement, calibration, checking, and testing work. Because no other type of instrument produces more precise results, this potentiometer has become the recognized standard for such work.

In the physical laboratory it has many other uses as well, such as measuring the e.m.f. of other cells by comparison with that of a standard cell; the measurement of the e.m.f. of thermocouples, providing a method for measuring temperatures with an accuracy equal to or better than the best mercury thermometers, and for any other purpose involving the measurement of potentials.



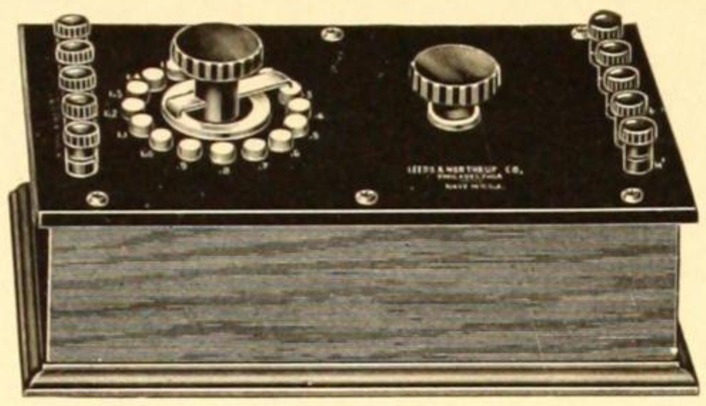
No. 2970E.

It reads direct up to 16.1 volts. It has three ranges, .161 volts down, 1.61 volts down, and 16.1 volts down. The essential electrical circuit consists of 15 five-ohm coils, series connected and having in series with them a slide wire, the resistance of which from 0 to 1100 on the scale is 5.5 ohms. A contact point makes contact between any two of the five-ohm coils, and another contact point makes contact at any point on the slide wire. The current flow through these resistances is regulated to exactly .02 ampere. Consequently, the fall of potential across any one coil is 0.1 volt and that across the slide wire 0.11 volt. The total potential drop over the 15 coils and wire is, therefore, 15x0.1+0.11, or 1.61 volts. Of this 1.5 volts can be varied by steps of 0.1 volts, and 0.11 volts by indicated steps of .00005 volts, and by estimation to .00001 volts or 10 microvolts. By changing the position of one plug the fall of potential over coils and wire is reduced to one-tenth its former value and the potentiometer reads to 0.161 volts down by indicated steps of .000005 volts, and by estimation to .000001 volt, or 1 microvolt. The resistances, being found on metal spools, are able to dissipate a comparatively large amount of energy. This allows the instrument to be used for the direct measurement of voltage up to 16.1 volts without the use of accessories.

For measurements using from three turns of the slide wire to three studs on the dial switch, the accuracy ranges from .1 to .01%. For all measurements utilizing three or more switch studs, the accuracy is .01% or better. The slide wire consists of 11 turns on a cylinder 15 cm. in diameter. It is about 470 cm. long and each turn represents .01 volt. The divisions representing 1/100 of a turn are about 6 mm. apart and are subdivided into ½ divisions. It is easy to estimate the division to tenths. The vertical scale shows the number of turns, and a circular scale the fraction of a turn.

In potentiometers having only ten slide wire turns (1000 divisions), it is very difficult to follow an e.m.f. fluctuating between values corresponding to scale readings from a point slightly under to a point slightly beyond the 1000 division mark. Naturally, to cover this range requires movement back and forth of the contact switch over two adjacent studs and the turning back and forth of the slide wire contact from one end of the wire to the other or through practically ten turns. To obviate this cumbersome procedure, the present model is made with 11 turns in 1100 divisions so that any fluctuation near the 1000 division mark can be followed with the same ease as at any other point on the scale.

The instrument is of the finest workmanship, material, and finish throughout, and is furnished with a booklet giving circuit diagrams, full directions, and other valuable information..... $250.00



No. 2975E.

2975E. Potentiometer, Students', L.&N. A highly accurate yet inexpensive instrument for teaching the principles and advantages of measuring unknown potentials by the potentiometer method. Features which adapt this instrument especially to student use are: 1. The accuracy is high enough for serious investigational work in physics, physical chemistry, metallurgy and instrument calibration. 2. Rugged and comparatively inexpensive. 3. Its flexibility permits of a wide variety of measurements in the educational laboratory. 4. The circuits within the instrument have been made simple enough to be clear to students, and all accessories, such as keys, switches, galvanometer and standard cell must be connected in circuit by the student. This procedure makes the student familiar with the potentiometer circuit. 5. In general, the design follows that of the No. 2970E Type K Precision Potentiometer, so that work with this students' pattern is excellent training for later work with the precision instrument.

The Students' Potentiometer is assembled on a grained bakelite top plate, mounted in a polished mahogany case, with cover.

Two ranges are provided: 0 to 16 millivolts, 0 to 16 volts. The desired range is selected by connecting to the proper binding post.

The low range is provided for temperature measurements with thermocouples. It permits comparatively low temperatures to be measured with base-metal thermocouples and high temperatures with noble-metal couples.

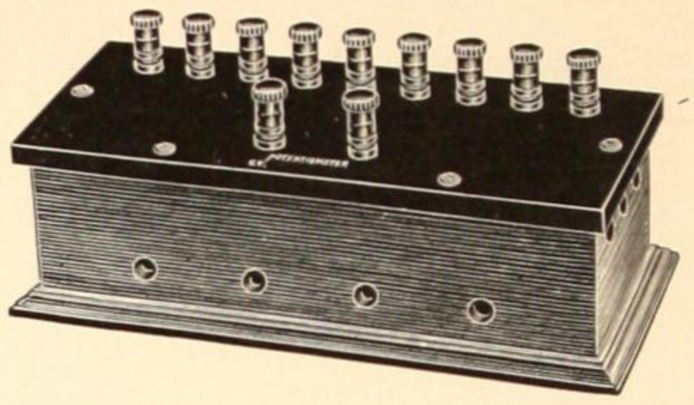
The potentiometer contains only the calibrated resistances, all accessory apparatus being external. The calibrated resistances comprise a series of fifteen 10-ohm coils, with a dial switch, and a 10-ohm circular slide wire. The dial resistances and the total resistance of the slide wire are adjusted to an accuracy of .04 per cent. The slide wire has one hundred uniform divisions, accurate to .5 division. Measurements on the 16-millivolt range are accurate to .005 millivolt and on the 1.6 volt range to .0005 volt.

There are no moving or sliding contacts within the potentiometer, except two contact points. All other connections are brazed or soldered. The moving contact points are in the galvanometer circuit and not in a calibrated resistance circuit, so that any variation in contact resistance at these points can cause no error in the measurements.

The connections to the calibrated resistances are brought out to ten binding posts, five on either end of the instrument. For potentiometer measurements only six binding posts are involved and only five are actually used. The six binding posts involved are the five located at left of the instrument and the one located in the central position on the right. The other four binding posts at the right of the instrument are provided for making independent connections to the slide wire, either with or without end coils, so that the instrument may be used as part of a Wheatstone bridge assembly. For this purpose an additional scale, 0 to 1000, is provided on the slide wire.

As illustrated, with booklet containing circuit diagrams, assemblies for various classes of measurements, and full instructions.....**$70.00**

2980E. Volt Box, L. & N. In order to calibrate a voltmeter, the range of which may be several times greater than the fundamental range of the potentiometer (1.60 or 1.61 volts), or to measure potentials exceeding the potentiometer range, a voltage multiplier known as a volt box is employed. This consists of a series of resistances so arranged that .1, .01, or .005 of the voltage thrown across its terminals can be measured with the potentiometer. Obviously the true voltage will then be the potentiometer reading multiplied by 10, 100, or 200, depending on the multiplier used. The three multipliers in this box are suitable for calibrating voltmeters with ranges of 15, 150, and 300 volts, respectively, and for measuring potentials falling within these ranges. Accuracy 1/25% **$50.00**



No. 2985E.

2985E. Volt Box, L. & N. Same as No. 2980E, but with multipliers for ranges of 3, 7.5, 15, 30, 75, 150, 300, and 750 volts. Accuracy 1/25%.....**$100.00**

2986E. Quinhydrone pH Indicator, L. & N. This Indicator is specially designed for use with quinhydrone electrodes. Either a calomel electrode or another quinhydrone electrode may be used as a reference. The scale is calibrated in millivolts, with a range equivalent to 1 to 9pH. The chart furnished converts millivolt readings into pH units. The guaranteed accuracy is within a limit of error of 0.04 pH. The sensitivity is 0.01 pH when the resistance of electrodes and solution is 5000 ohms or less. A special circuit makes it unnecessary for the user to reverse the connections when the quinhydrone electrode becomes positive with respect to the calomel electrode.

Practically any solution whose pH value is between 1 and 9 can be measured with this Indicator, and the quinhydrone electrode is faster, simpler and easier to operate than a hydrogen electrode. A bare gold electrode is used. It is not supplied with hydrogen, but a few grains of quinhydrone are dissolved in the solution. The potential of the electrode in a solution containing quinhydrone is proportional to the pH value of the solution.

Quinhydrone is seldom used when the fundamentals of pH measurements are being studied, but it is rapidly growing in favor where the measurement, rather than the method, is of interest. Physiologists, public-health workers, and chemists in the leather, water-works, ceramic and similar industries are among the principal users.

This portable Indicator together with Nos. 2987E and 2988E Electrodes and chemicals listed below constitute a most satisfactory low-cost assembly for pH work. Many such assemblies are in use and are giving complete satisfaction.....**$50.00**

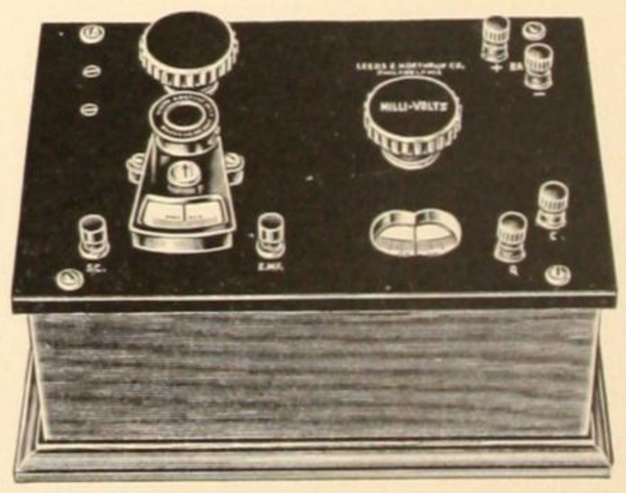
2987E. Calomel Electrode Vessel, Wilson Modification. An improved form of laboratory glass electrode designed to minimize contamination from the outside, and to reduce contamination by diffusion. Recommended particularly for use with No. 2986E **$10.00**

2988E. Quinhydrone Electrode, Dip Type. Consists of a gold wire 18″ long coiled on a glass tube and fused to a platinum wire which is sealed in one end of the tube. Recommended particularly for use with No. 2986E **$4.00**

2989E. Standard Package of Chemicals, for Calomel Electrode. Includes 8 oz. Mercury, 1 oz. Calomel and 1 lb. Potassium Chloride, all of a purity best suited for pH work. The quantities are sufficient for ordinary purposes **$4.70**

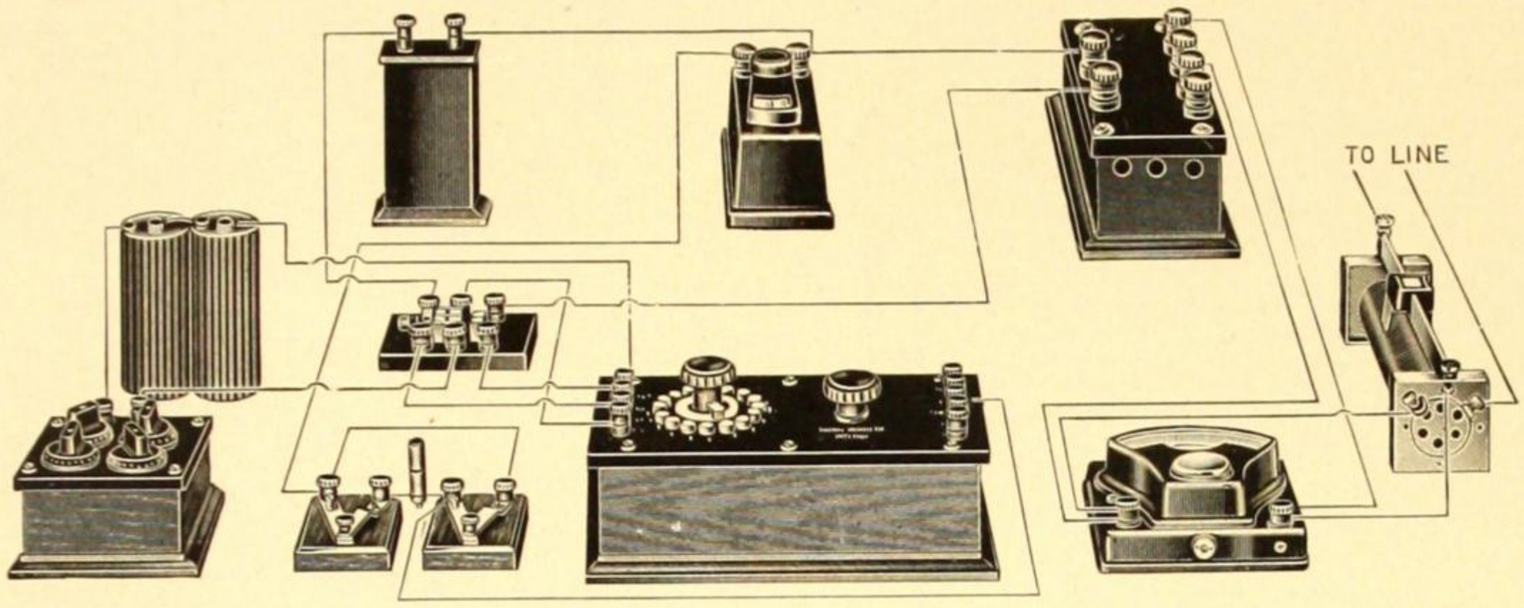
2991E. Quinhydrone. 2 oz. bottle..... **2.25**

2992E. Standard Acetate Solution. For checking the performance of quinhydrone electrodes. One liter bottle **$3.50**



No. 2986E.

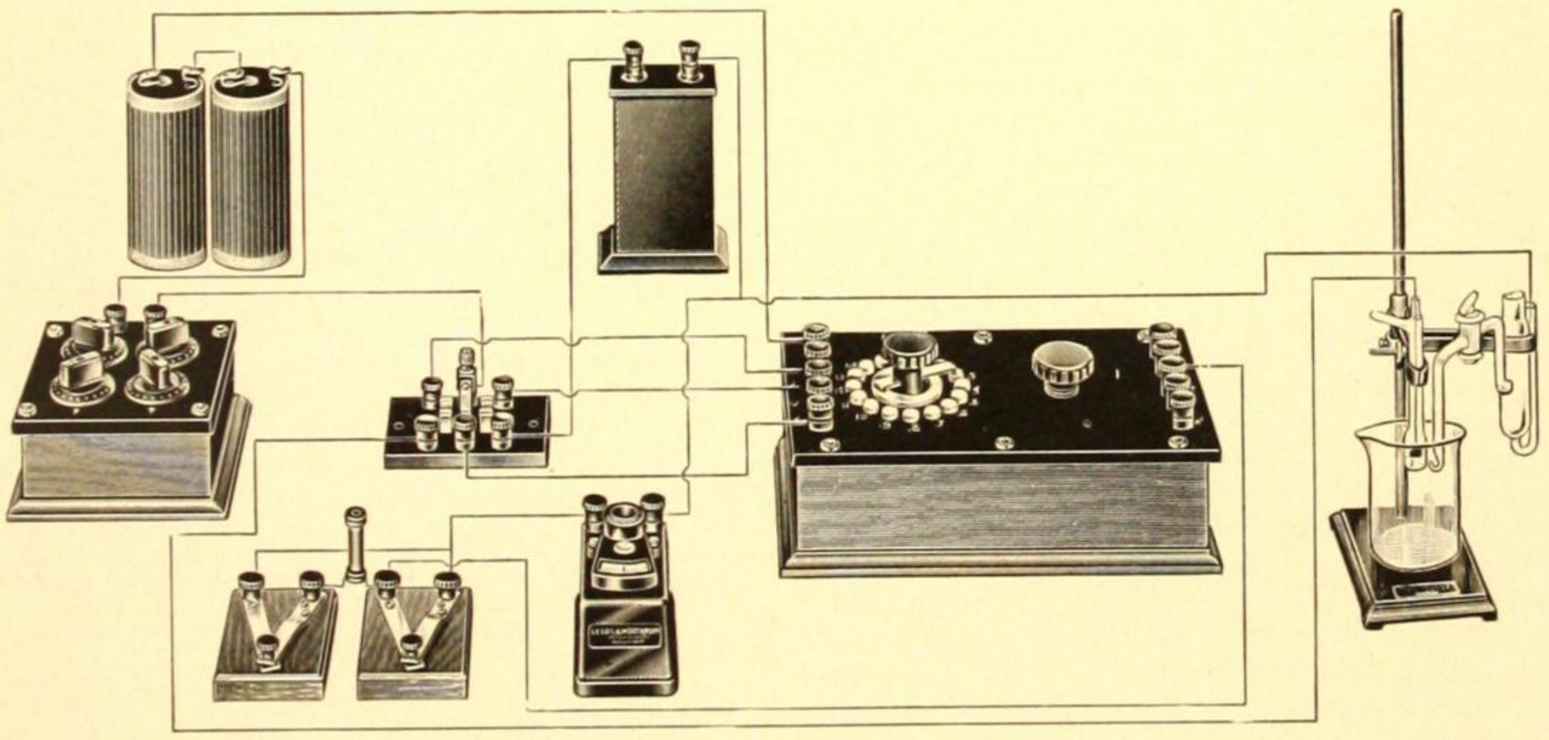
Voltmeter Calibration



The illustration above shows the Students' Potentiometer and the accessories necessary for measuring voltage and calibrating voltmeters. If a higher sensitivity is required, the Type P Galvanometer, listed elsewhere, can be substituted for the pointer type shown above.

2975E.	Students' Potentiometer	$70.00
2980E.	Volt Box, Ranges 15, 150, 300 Volts	50.00
2995EC.	Resistance Box, 4-dial	40.00
2360EC.	Galvanometer, Pointer Type	15.00
2130E.	Standard Cell, Eppley	10.00
3292.	Switch, Double, pole, Double-throw	2.50
3702.	Single Contact Keys (2 needed), Each $3.00	6.00
4198A.	Protective Resistance, 10,000 Ohms	3.50
	Total	$197.00

Laboratory Hydrogen Ion Test



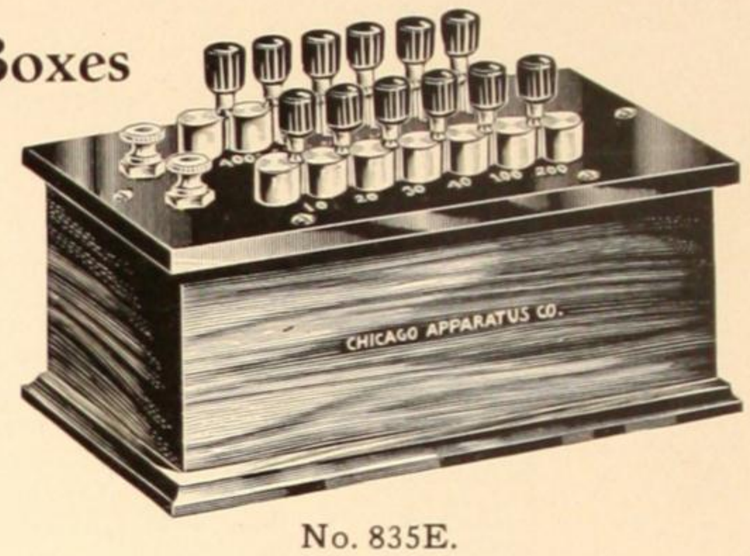
In view of the widespread use of the No. 2975E Students' Potentiometer in chemical and physical chemistry laboratories, it has been designed to make it useful for electrolytic conductivity measurements and temperature measurements with thermocouples, as well as for hydrogen ion measurements. The illustration above shows the Students' Potentiometer in an assembly for the measurement of hydrogen ion concentration. It consists of the following:

2975E.	Students' Potentiometer	$70.00
2995EC.	Resistance Box, 4-dial	40.00
2130E.	Standard Cadmium Cell, Eppley	10.00
2360ED.	Galvanometer, Pointer Type	15.00
3702.	Single Contact Key, 2 Required, Each $3.00	6.00
3292.	Switch, Double-pole, Double-throw	2.50
7687.	Hydrogen Electrode, Hildebrand	5.50
7697.	Calomel-electrode Vessel	5.00
	Total, excluding Beaker, Clamps and Stand	$154.00

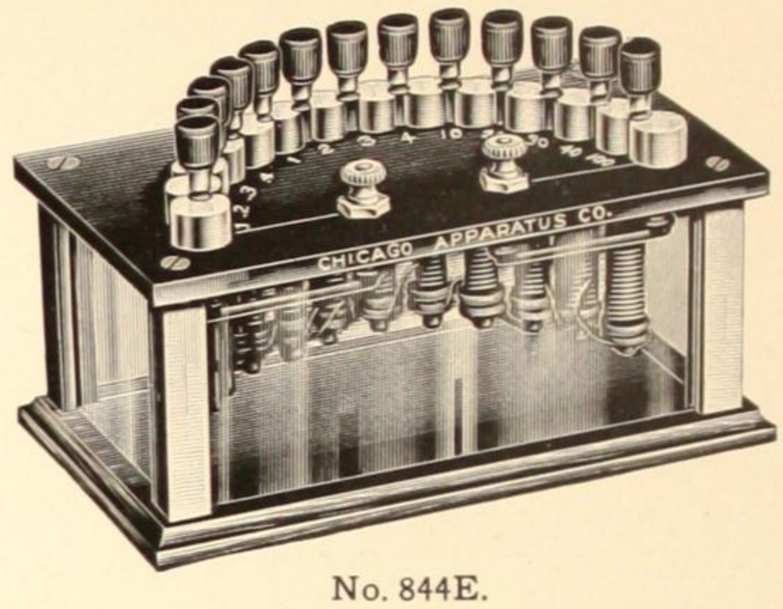
Resistance Boxes



No. 833E.



No. 835E.



No. 844E.

The accuracy, reliability, and permanency of resistance boxes depends entirely upon skillful construction with proper materials. In the Milvay Standard Resistance Boxes the following constructional features are deserving of serious consideration because they insure greater accuracy and longer service:

Boxes. Finely constructed of hardwood with polished mahogany finish.

Tops. Highest grade hard rubber plates ¼ inch thick, providing a non-yielding firm anchorage for the brass blocks.

Blocks. Large size, anchored to the rubber top by screws and pins—the latter absolutely preventing turning or shifting. There is practically no "give," and consequently no loosening of plugs due to withdrawal of neighboring plugs. The large space between the blocks is ample for easy cleaning and provides proper insulation.

Plugs. These are ¼ inch in diameter, accurately machined to uniform size and taper. The taper part comes just below the top of the blocks, so that no ridges or grooves can develop to spoil the perfect contact. The knurled hard rubber tops are non-removable.

Coils. The wire used is a nickel copper alloy with a temperature coefficient of .000005 per degree centigrade; which means that no possible rise in temperature will measurably affect the resistance. The coils are wound bifilar on wooden spools so that these boxes are suitable for use in conductivity, experiments with alternating currents. The spools are firmly locked to the top, leaving the connecting wires entirely free from strain. Since no acids or other corrosive materials are used in soldering, all connections can be relied upon for permanency.

Accuracy. Each coil is carefully calibrated and then allowed to age for a year or more, during which period they are tested at regular intervals. No coil is used until its resistance ceases to vary. After being connected into the box circuit they are again tested and rechecked. Because of the careful aging, the number of tests made, the methods employed, and the extremely accurate instruments used, Milvay Standard Resistance Boxes will be found well within their rated accuracies.

Guarantee. We unconditionally guarantee every Milvay Standard Resistance Box to be of high grade workmanship and material, and accurate as specified. Full refund or replacement will be made on any box that does not conform to these high standards.

833E. Resistance Box, Milvay Standard, with 13 Coils and Total Capacity of 211 Ohms. This box has nearly double the capacity of two row types selling at the same price. In addition it offers these advantages: A semi-circular coil arrangement which allows plugs to be manipulated more easily and more quickly; figures that are always in plain view so that the total resistance employed can be ascertained more easily and with less chance of error. The thirteen coils are as follows: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, 10, 20, 30, 40 and 100 ohms. On 12x20 cm. box. Coils are adjusted to an accuracy of 1/5% **$13.50**

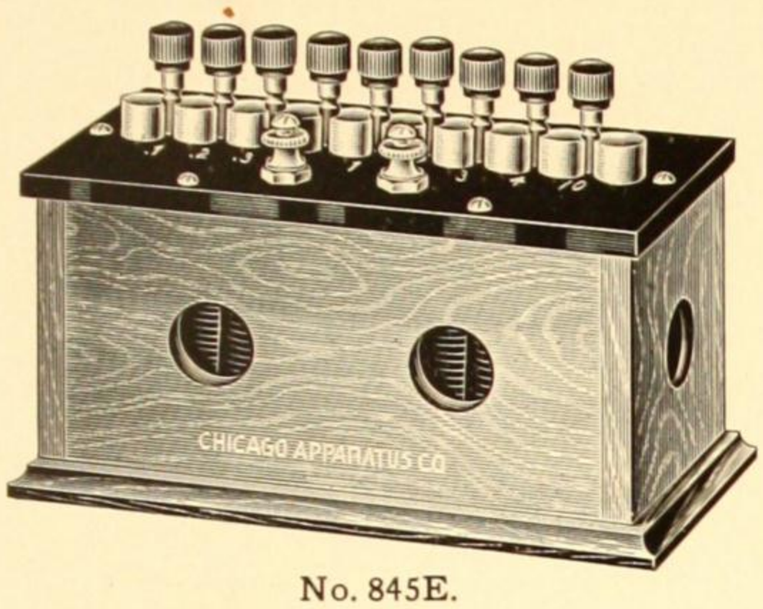
835E. Resistance Box, Milvay Standard, with 12 Coils and Total Capacity of 11,100. The values of the individual coils are 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000 and 4000 ohms. This box, when used with our No. 833E Resistance Box (0.1 to 211 ohms), provides a resistance range of 0.1 to 11,311 ohms, variable in steps of 0.1 ohm. When used with our No. 843E Resistance Box (1 to 2110 ohms), the total range becomes 1 to 13,210 ohms, variable in steps of 1 ohm. Accuracy, 1/5%. Size, 12 x 20 cm. **$20.00**

843E. Resistance Box, Milvay Standard, with 13 Coils and Total Capacity of 2110 Ohms. Same design and same advantages as No. 833E, but with thirteen coils as follows: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400 and 1000 ohms. On 12x20 cm. box. Guaranteed accuracy 1/5% **$15.00**

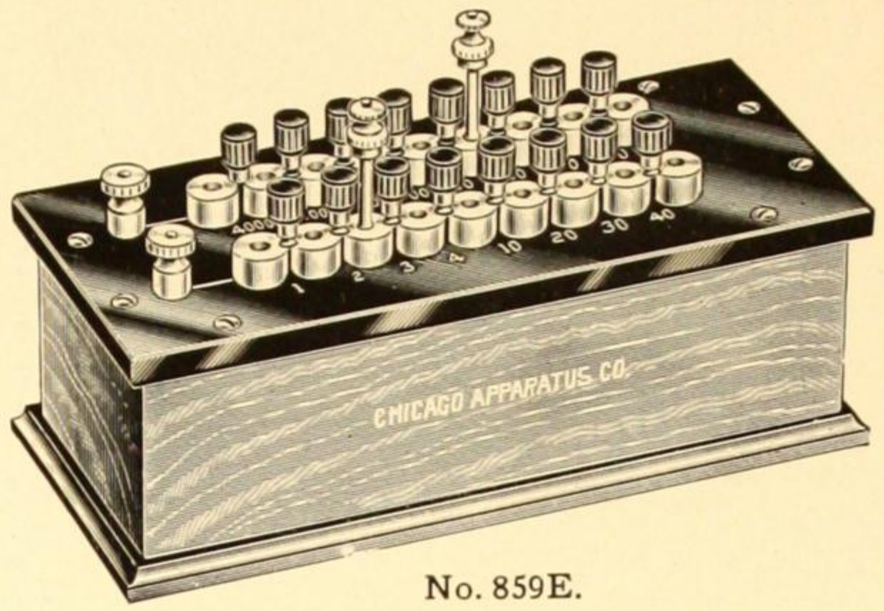
844E. Resistance Box, Milvay Glass-Side. Shows the manner in which the coils in a standard resistance box are connected.

Also shows why current is obliged to pass through a coil when its plug is out and not when the plug is in. In all details exactly like No. 833E except that the four sides are of glass to reveal the internal constructional details. Number of coils—13; resistance range—0.1 to 211 ohms; accuracy of adjustment—1/5%. A fine demonstration instrument with the added advantage of being suitable for students' laboratory work as well.

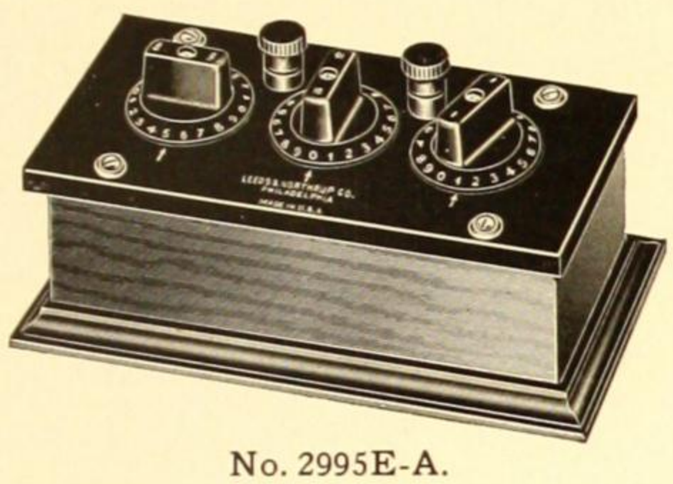
Price **$16.00**



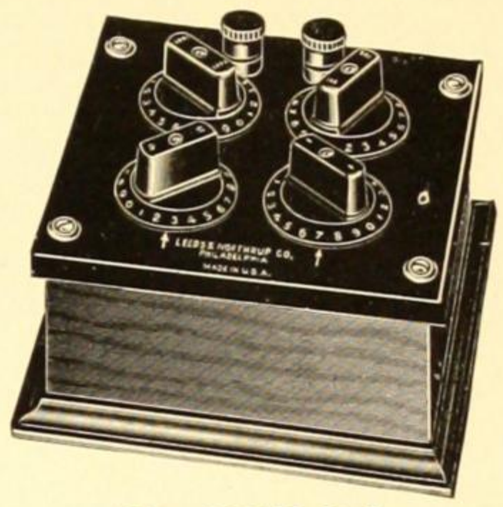
No. 845E.



No. 859E.



No. 2995E-A.



Nos. 2995E-B-C.

845E. Resistance Box, Milvay Standard, High Capacity. With 9 Coils and Total Resistance of 21 Ohms. Instructors who have repeatedly been troubled by the burning out of resistance boxes of the low capacity type will welcome this high capacity box. It is especially valuable for the verification of Ohm's Law where the potential is measured by a voltmeter and the current by an ammeter—for the calibration of ammeters and galvanometers by employing a constant source of potential—and other experiments where the exact resistance must be known and yet the current be large enough for accurate measurement by an ammeter. The coils are wound, of very heavy wire of negligible temperature coefficient, on large brass tubes. To further dissipate any heat generated, the box is provided with six openings to provide ample ventilation. The fractional coils will carry 6 amperes; the one and two ohm coils 4 amperes; and the three, four and ten ohm coils 2 amperes. These currents will not overheat the coils for at least ten minutes. Somewhat larger currents may be used for shorter periods. The nine coils are as follows: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, and 10 ohms. On 12x20 cm. box. Coils are adjusted to an accuracy of 1/5% **$22.50**

859E. Resistance Box, Travelling Plug Type, Milvay, with 16 Coils and Total Resistance of 11,110 Ohms. Each block is provided with a tapered hole into which the travelling plugs, two in number, fit. This travelling plug arrangement is useful in comparison of the E.M.F. of batteries and other tests by the potentiometer method.

Tops—Highest grade hard rubber plates 3/8 inch thick.

Blocks—Extra large and heavy, fastened with two screws and four taper pins—a construction that absolutely eliminates "give" and makes turning or shifting impossible.

Plugs—Absolutely uniform in size and taper—about 3/8 inch in diameter. The taper part comes below the top of the brass blocks so that ridges cannot wear into the plug.

Coils—The wire is genuine Manganin—the only resistance wire having both a negligible temperature coefficient and no thermo-electric effect with brass and copper. The wire used is of ample size, wound bifilar, and thus free from induction, so that the boxes may be used in experiments with alternating currents.

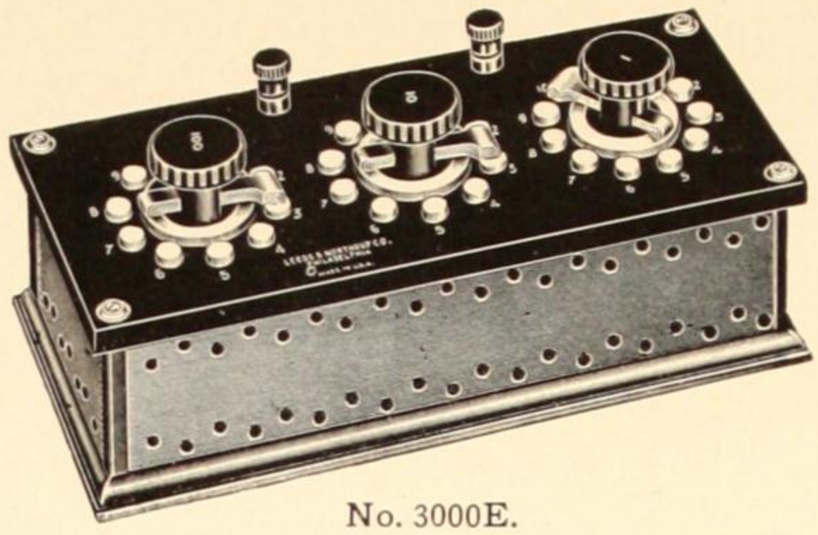
Boxes—Extra heavy and extra strong, of genuine mahogany wood with finest hand rubbed finish.

The resistance of the sixteen coils are as follows: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, and 400 ohms. Size of box 12.5x28 cm. Coils are adjusted to an accuracy of 1/10%. Including two travelling plugs **$40.00**

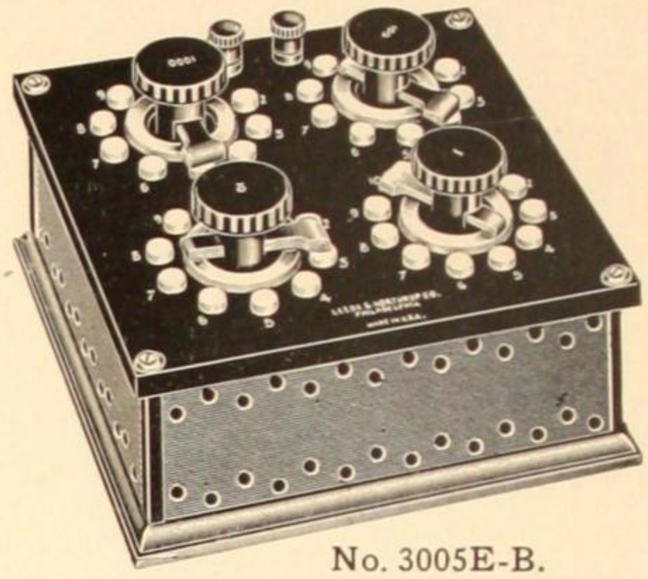
2995E. Resistance Box, Dial Pattern, L. & N. Accuracy 1/10%. Each dial controls, through an enclosed switch, one decade of resistance values. Provides, by merely turning the dials, any resistance up to the maximum, in steps of 1 ohm. Further, the position of the dials always indicates the total resistance. There are no plugs to manipulate or lose, no exposed contacts to foul or clean, and no errors due to loose or poorly fitting plugs.

The coils are bifilar wound on metal spools and dissipate 0.5 watt in open air and somewhat less in the box. Because of their convenience and many advantages these high-grade instruments are very popular with educational laboratories.

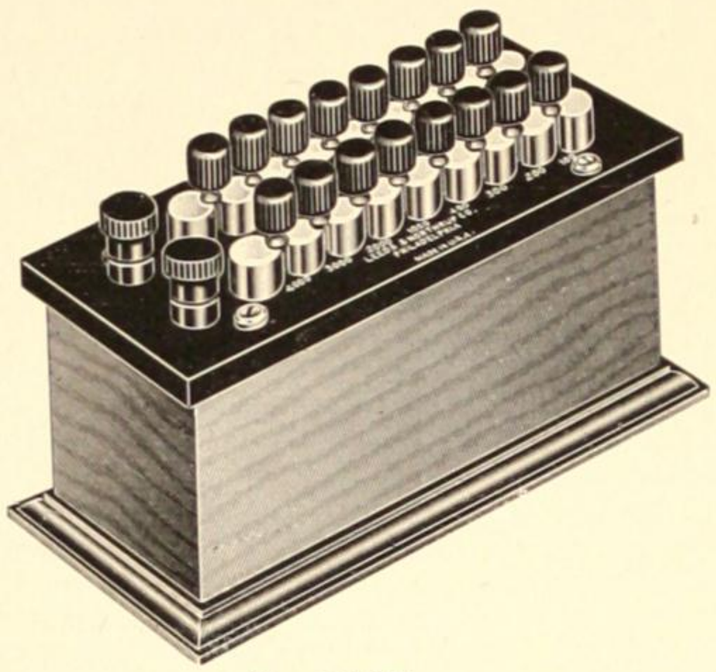
No.	A	B	C
No. of dials.....	3	4	4
Range, ohms	999	9999	999
Smallest step, ohms	1	1	0.1
Largest step, ohms	100	1000	100
Each	**$33.00**	**40.00**	**40.00**



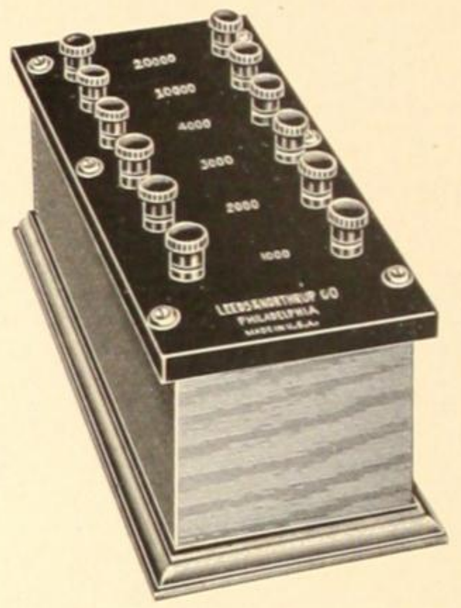
No. 3000E.



No. 3005E-B.



No. 3010E.



No. 3015E.

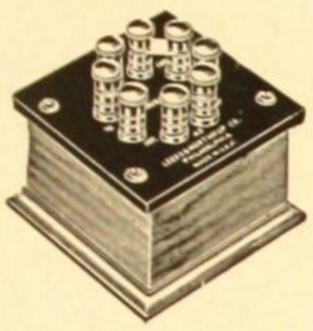
3000E. Resistance Box, Precision Dial Type, L. & N. Accuracy 1/20%. For electrolytic measurements and other alternating current work at audio frequencies. Also may be used on direct current. The coils are bifilar wound on non-metallic spools and dissipate 0.25 watt. The three dials, each controlling a decade of resistance values, provide up to 1000 ohms resistance in steps of 1 ohm. The sides of the box are perforated metal, so that the coils may cool rapidly. Further, the entire box may be immersed in oil to increase current-carrying capacity. Each of the six blades in the switches makes independent contact, assuring freedom from all contact errors.....**$75.00**

3005E. Resistance Boxes, Open-dial Precision Type, L. & N. High accuracy with construction in keeping, characterizes this fine instrument. The dial switches are of extremely substantial construction, insuring minimum contact resistance and wear. Coils are wound on metal spools and rated at 0.5 watt per coil. They are soldered directly to the switch studs, increasing radiation and thereby the current-carrying capacity of the coils. To still further increase the carrying capacity the case, of black metal, is perforated. The lowest resistance dial has 10 coils, so as to permit inter-comparison between dials; all others have nine coils. The top plates are heavy polished hard rubber and each box is equipped with a polished mahogany cover to protect the box when not in use. Accuracy 1/20%.

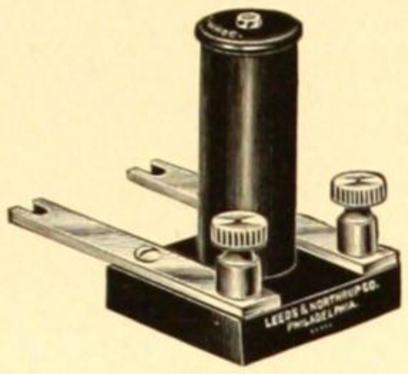
No.	A	B
No. of dials	3	4
Range, ohms	1000	10000
Smallest step, ohms	1	1
Largest step, ohms	100	1000
Each	**$70.00**	**100.00**

3010E. Resistance Box, Post Office Pattern, L. & N. While dial type resistance boxes are more popular than plug boxes, the latter—in the post-office pattern—has the advantage of lower cost for the same range, quality, and accuracy. Standard plug and block construction is utilized in this box. The coils are wound on metal spools and are rated 1.0 watt per coil. They are soldered to rods integral with the exposed studs, thus increasing their carrying capacity. This is an important feature in boxes for use in educational laboratories where they are apt to be overloaded by students. The plugs and blocks are gold lacquered and are assembled on a polished hard rubber top plate and enclosed in a polished mahogany case with cover. Has 16 coils on the 1, 2, 3, 4 plan with a total resistance of 11,110 ohms, variable in steps as small as 1 ohm. Accuracy 1/10%....**$36.00**

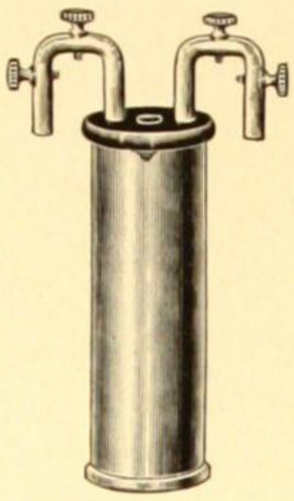
3015E. Resistance Box, Precision Type, with Curtis Coils. Accuracy 1/25%. For use on audio-frequency alternating current circuits such as are employed in electrolytic conductivity measurements. Contains six Curtis coils having values as follows: 1000, 2000, 3000, 4000, 10,000, and 20,000 ohms; total, 40,000 ohms. When used in connection with No. 3000E Box, the two boxes provide a resistance of 41,000 ohms in steps of 1 ohm. The terminals of each coil are brought out to separate binding posts and the various combinations are obtained by the proper connections to these posts. The Curtis coils in this box are free from frequency errors and a full discussion of this type of coil will be found in Bureau of Standards Scientific Paper No. 177.....**$75.00**



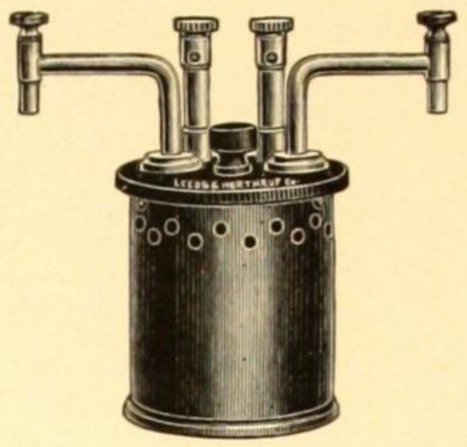
No. 3020E.



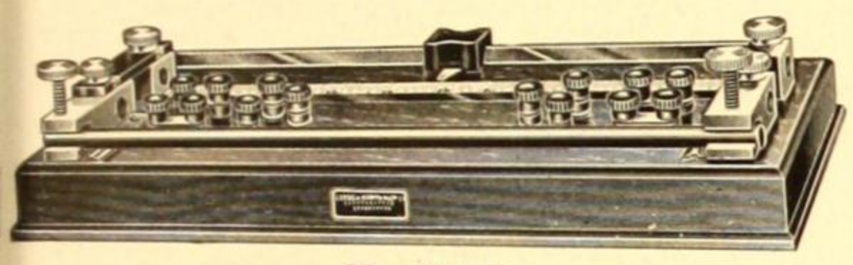
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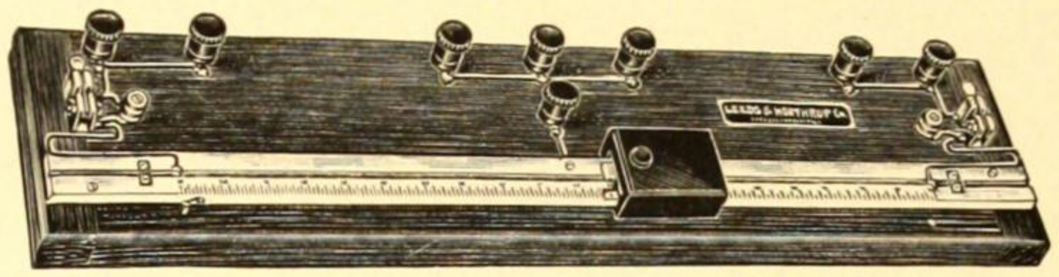
No. 3030E.



No. 3035E.



No. 3040E.



No. 3045E.

3020E. Resistance Box, High Values. Accuracy 1/10%. Designed for student's use in measurements involving high resistances. Contains four coils with values of 10,000, 20,000, 30,000 and 40,000 ohms. Coils are bifilar wound on metal spools and dissipate 1.0 watt in open air. Binding posts are mounted on insulating pillars to increase resistance and to prevent surface leakage. Series connections between posts are made by means of links.....**$65.00**

3025E. Resistance Standards, General Utility Pattern, L. & N. Accuracy 1/10% for loads up to 1 watt. A satisfactory standard for student use. Neatly mounted on hard rubber base and provided with both binding post and copper spade terminals, the latter for connecting with bridge terminals. The winding is bifilar and inclosed in a metal protecting housing.

No.	A	B	C	D	E
Resistance value, ohms ..	1	10	100	1000	10000
Each	**$10.00**	**10.00**	**10.00**	**10.00**	**10.00**

3030E. Resistance Standards, N. B. S., L. & N. Accuracy 1/100% up to 1/10 watt and 1/25% up to 1 watt. For work of the utmost accuracy, the use of temperature control by means of oil baths is advisable. These National Bureau of Standards Pattern Resistances are accurate and of definite value under all conditions of normal use. Furthermore, they do not suffer resistance changes with the lapse of time or changes in humidity. They are mounted in hermetically sealed metal cases, entirely filled with oil from which all air and moisture has been expelled by boiling.

No.	A	B	C	D	E
Resistance value, ohms ..	1	10	100	1000	10000
Each	**$20.00**	**20.00**	**20.00**	**20.00**	**25.00**

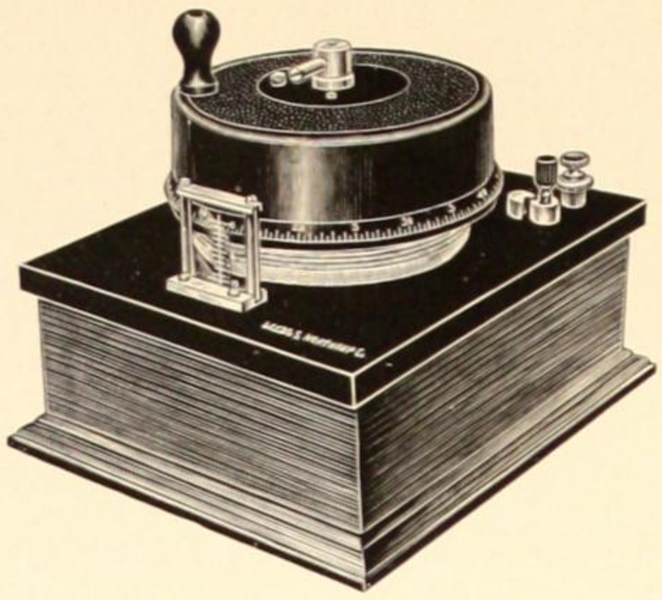
3035E. Resistance Standards, Reichanstalt Pattern, L. & N. Accuracy: In oil, 1/50% up to 1 watt and 1/20% up to 10 watts. Made only in low resistance values and are well suited for use in ammeter calibration work by the potentiometer method. Mounted in perforated metal case and provided with both current and potential terminals.

No.	A	B	C
Resistance values, ohms.....	0.1	0.01	0.001
Each	**$50.00**	**55.00**	**120.00**

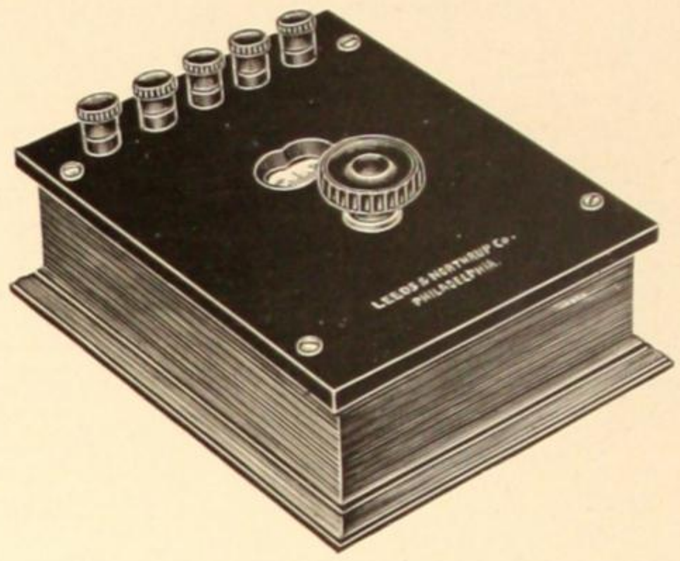
3040E. Kelvin Bridge, Students', L. & N. A well-designed instrument especially intended for student use in the measurement of low resistances. The range is from .001 to .1 ohm. The two ratio coils are accurate to 1/5% and the low resistance standard with sliding contact to 1%. Clamps for holding the sample are made integral with the instrument.**$70.00**

3045E. Wheatstone Bridge, Calibrated Slide Wire, L. & N. Extended coil type. One of the most useful forms of calibrated resistances is the slide wire. Its flexibility permits its use for making up the numerous special bridge and potentiometer circuits encountered in research and other work. This compact inexpensive slide wire finds its greatest use in educational laboratories where the exposed wiring is helpful in giving the student a clear understanding of the circuits, which in principle are not unlike those employed in the refined types listed below. The slide wire is of the helical type, resulting in a high resistance which is usually desirable in measurements of electrolytic conductivity.

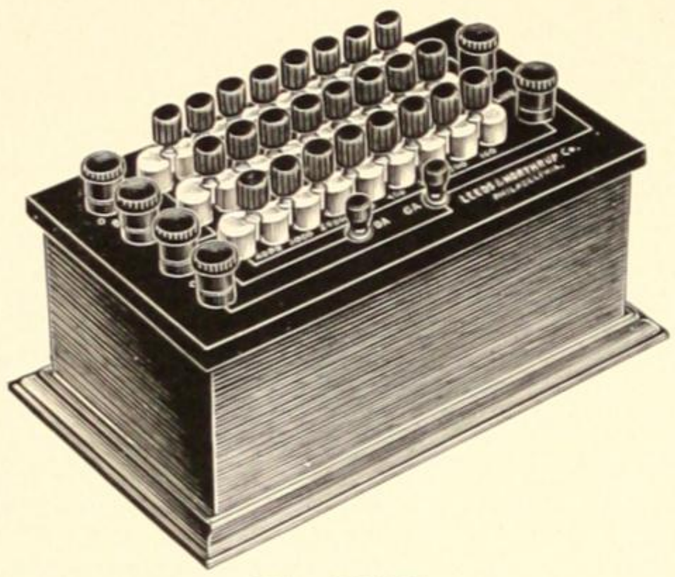
Resistance of slide wire, about 30 ohms; length, 40 cm.; scale, calibrated in 100 divisions, accurate to 1 division; equipped with two end coils, each having 4.5 times the resistance of the slide wire and adjusted to an accuracy of 1/5%. Switches are provided to short circuit these coils when not wanted.....**$30.00**



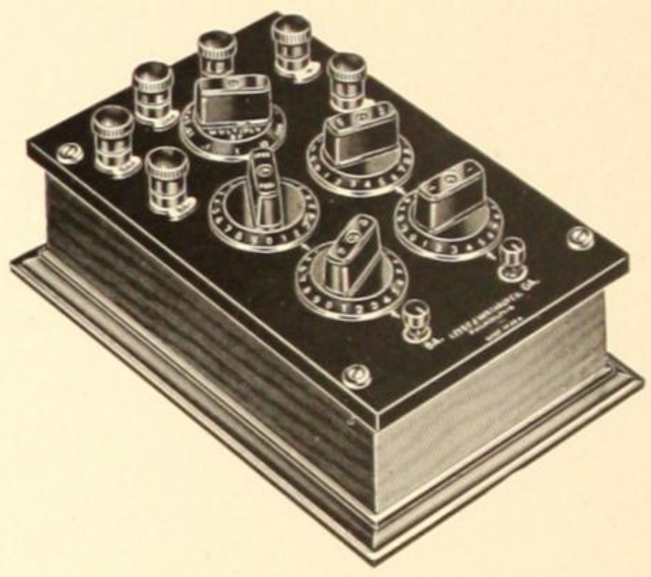
No. 3050E.



No. 3055E.



No. 3060E.



No. 3065E.

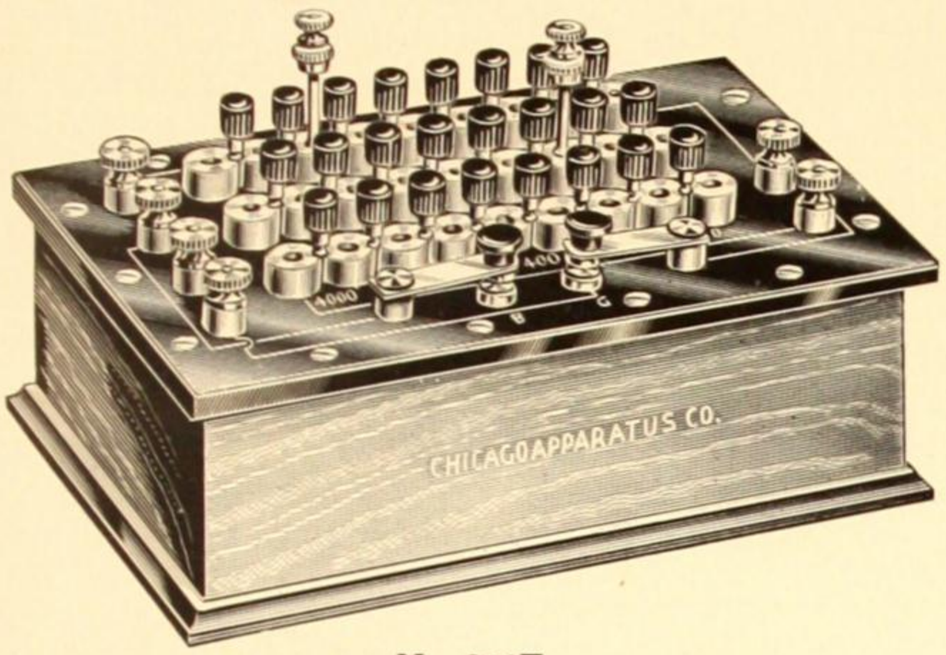
3050E. Wheatstone Bridge, Kohlrausch Slide Wire, L. & N. Precision type for research and other work requiring a high degree of accuracy. With the end coils employed, this form provides a very long slide wire in compact form. The slide wire has a resistance of about 7 ohms, is 470 cm. long, and is divided into 1000 divisions, with ½ divisions indicated. It is accurate to ¼ division, and readable to 1/10 division. Two-plug controlled end coils are provided and these are adjusted to 4.5 times the resistance of the slide wire. They are accurate to 1/25th of 1%. The vertical scale shows the whole number of turns, and the circular scale the fractions of a turn. **$100.00**

3055E. Wheatstone Bridge, Kohlrausch Slide Wire, L. & N. In this instrument the slide wire is in circular form and together with the sliding contact mechanism is protected against corrosion by being enclosed in a fine wood box with hard rubber top. The slide wire has a resistance of about 100 ohms and is 35 cm. in length. The scale is calibrated in 100 divisions and is accurate to ½ division. Two end coils are adjusted to 4.5 times the resistance of the slide wire and are accurate to 1/10%. These coils may be cut out of circuit when not wanted. The scale is viewed through an opening in the top and the movement of the sliding contact is controlled by a large knob at the top center of the instrument **$40.00**

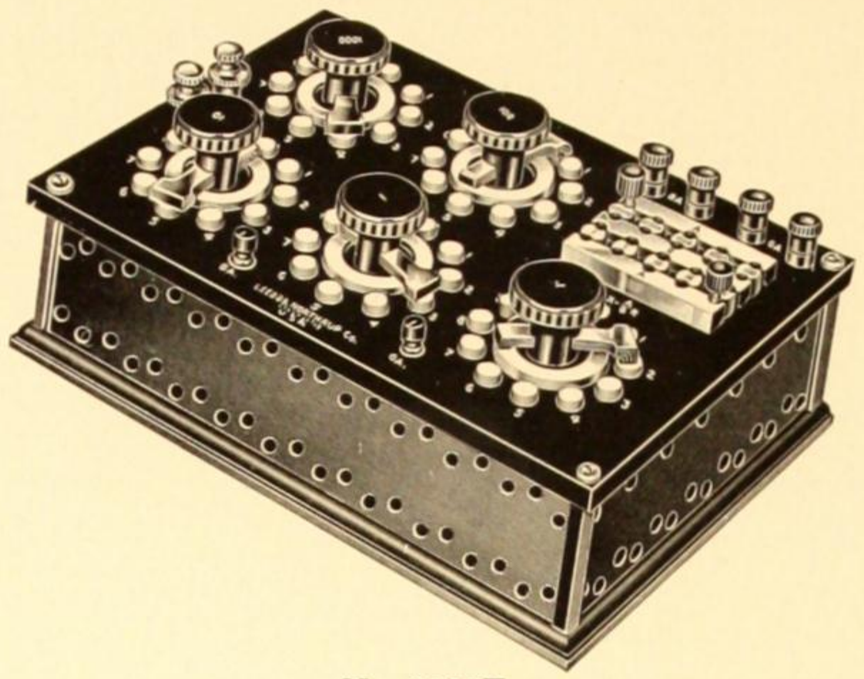
3060E. Wheatstone Bridge, Post Office Type, L. & N. Accuracy: Rheostat coils 1/10%, ratio coils 1/20%. This fine instrument is recognized everywhere as the best pattern for students' use in practical measurements. The rheostat contains 16 coils, plug controlled, ranging from 1 to 4000 ohms, providing a balancing resistance of 11,110 ohms in steps of 1 ohm. The two ratio arms contain four coils each—1, 10, 100, and 1000 ohms. All coils are bifilar wound on metal spools. Binding posts are provided for battery, galvanometer, and unknown resistance, and push button switches for closing the battery and galvanometer circuits. The plain markings on the hard rubber top make it easy to trace circuits and connections. In polished mahogany box..... **$60.00**

3065E. Wheatstone Bridge, Dial Form, L. & N. The dial control and enclosed switch construction is the same as in No. 2995E Resistance Boxes, thus affording the same advantages. The rheostat contains four dial decades providing a resistance of 9,999 ohms in steps of 1 ohm. The coils are adjusted to an accuracy of 1/10%. The ratio arms with single dial control contain seven multipliers, .001, .01, .1, 1, 10, 100, and 1000, adjusted to an accuracy of 1/20%.

The above combination makes possible the measurement of unknown resistances from .001 to 9,999,000 ohms, amply covering every laboratory need. Push-button-type keys for closing the galvanometer and battery circuits are provided, also binding posts for connecting the unknown resistance, galvanometer, and battery into the bridge circuit. In finely polished mahogany box. No. 2275E, Type R, Galvanometer is recommended for use with this bridge **$55.00**



No. 864E.



No. 3070E.

864E. Resistance Box and Wheatstone Bridge, Milvay College Grade, with 24 Coils. There are sixteen rheostat coils as follows: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000, and 4000 ohms. The bridge ratio coils number eight; 1000, 100, 10, 1, 10, 100, and 1000 ohms. The combination makes possible a total range of measurement from .001 to 11,110,000 ohms. Each block is provided with a tapered hole into which traveling plugs, two in number, fit. This traveling plug arrangement is useful in the comparison of the E.M.F. of batteries and other tests by the potentiometer method. Binding posts for connecting in the battery, galvanometer and unknown resistance are conveniently located on the sides and respectively marked "B," "G" and "X." In this position all connecting wires are out of the operator's way. The contact keys are provided with large silver points and are most conveniently located in front. The hidden circuit is the simplest possible and easy to trace as it is indicated by white lines on the hard rubber top. Size of the box 17.5x28 cm. Rheostat coils are adjusted to an accuracy of 1/10%; the bridge ratio coils to 1/20%. Including two traveling plugs **$50.00**

3070E. Wheatstone Bridge, Open-dial Precision Type, L. & N. For the measurement of unknown resistances to a very high degree of accuracy. The rheostat contains five dial decades providing a resistance of 10,000 ohms which can be varied in steps as small as .1 ohm. Accuracy of 0.1 ohm decade, 1/10%; 1, 10, 100, and 1000 ohm decades, 1/20%. The ratio arms contain ten plug-controlled coils, 2 each 1, 10, 100, 1000, and 10,000 ohms adjusted to an accuracy of 1/40%. The above combination provides a measuring range of .0001 to 10,000,000 ohms. Battery and galvanometer keys are provided, also binding posts for unknown resistance, battery, and galvanometer leads. The ebonite top is extra heavy and the metal box perforated. No. 2275E, Type R, Galvanometer is recommended for use with this bridge **$175.00**



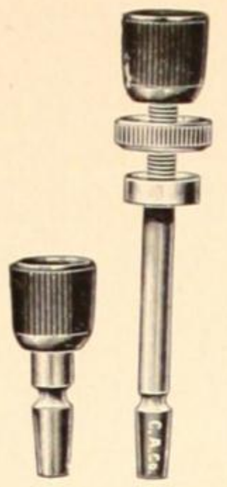
No. 3075E.

3075E. Testing Set, Portable, L. & N. This instrument, while primarily designed for portable use, is very popular for laboratory testing because of its completeness and compact arrangement. It consists of an enclosed dial Wheatstone Bridge of the same pattern as No. 3065E, galvanometer, battery, and all necessary control keys, and switches mounted in a strong oak case with hinged lid. A leather handle for carrying is provided. The whole constitutes a rugged unit capable of long hard service. The rheostat contains four dial decades, providing a total resistance of 9999 ohms in steps of 1 ohm. The ratio arms are controlled by a single dial and contain seven multipliers—.001, .01, .1, 1, 10, 100, 1000. The measuring range, therefore, is .0001 to 9,999,000 ohms, which is ample for every laboratory purpose—from the measurement of the low resistance of thermo-couples to the high resistance of insulating materials.

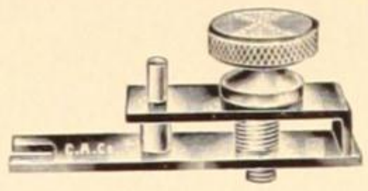
Switches for changing the connections of the instruments for locating faults by the Murray and Varley Loop methods are conveniently arranged. Testing for "opens" on cables, telephone, and telegraph lines by the buzzer and telephone receiver method is also possible with this instrument.

The galvanometer, of the knife edge pointer type, has a coil resistance of 200 ohms and a sensitivity of 1 megohm. The accuracy of the rheostat coils is 1/10% and of the ratio coils 1/20%. The case measures 8¾x7¼x5 inches and weighs 8½ pounds. Complete with booklet of information and directions for use **$90.00**

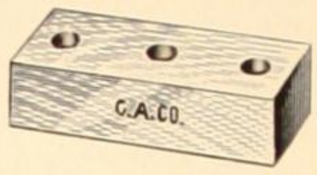
3080E. Extra Battery, for No. 3075E..... **1.00**



No. 867E. No. 868E.



No. 871E.



No. 875E.



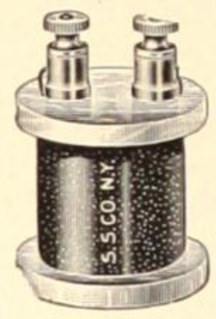
No. 876E.



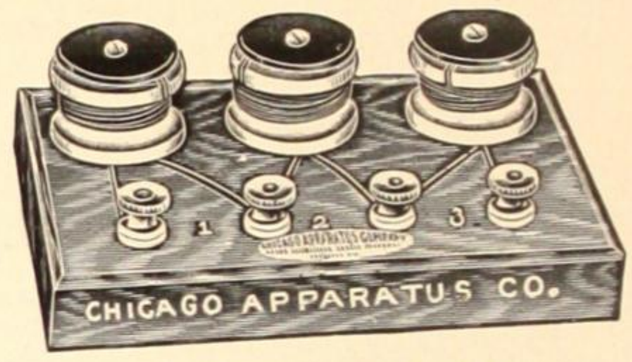
No. 878E.



No. 883E.



No. 895E.



No. 898E.



No. 899E.

867E. Extra Plug. For replacement to fit Resistance Boxes Nos. 833E, 834E, 845E, 859E; Bridges Nos. 864E and 1073E; and Resistance Spools No. 913E. Brass, with molded hard rubber top.....**$0.25**

868E. Extra Traveling Plug. For replacement to fit Resistance Box No. 859E and Bridge No. 864E. Brass, with molded hard rubber top.....**$1.35**

871E. Bridge Clips. For convenience in connecting resistances having wire terminals, into the "X" circuit of bridges of the box type like our No. 864E. **Per pair** **$1.25**

875E. Resistance Support Block. Finely finished wooden block with three deep mercury wells for supporting the large U-shaped pieces of copper rod used in experiments on specific resistance. See Exp. 29, Taylor, Watson and Howe's, "General Physics for the Laboratory".....**$0.75**

876E. Resistance Support Block. For support and connecting coiled lengths of wires used in laws of resistance experiments as outlined in Exp. 64, "Laboratory Exercises in Physics," by Fuller, Brownlee, and Baker (1927). A finely finished board on which three double Fahnestock binding posts are mounted three inches apart.....**$1.25**

878E. Resistance Coil. 1 ohm. As used in Millikan, Gale and Bishop's Course. For use in Wheatstone Bridge experiments. Insulated copper wire, non-inductively wound on wood spool 20 mm. high and 45 mm. in diameter.....**$0.35**

880E. Resistance Coil, 100 Ohms. Otherwise same as No. 878E.....**$0.50**

881E. Resistance Coil, 500 Ohms. Otherwise same as No. 878E **$0.50**

883E. Resistance Coil, 1000 Ohms. Same as No. 878E, but wound with insulated German silver wire..**$0.60**

888E. Resistance Coil. Same as No. 878E, but wound with 50 feet of No. 30 insulated copper wire....**$0.50**

889E. Resistance Coil. Contains 50 cm. No. 30 Iron Wire **$0.50**

890E. Resistance Coil. Contains 25 cm. No. 30 German Silver Wire **$0.50**

891E. Resistance Coil. Contains 50 cm. No. 24 German Silver Wire.....**$0.50**

893E. Resistance Coil. Same as No. 878E, but wound with 3 meters of No. 30 insulated copper wire..**$0.50**

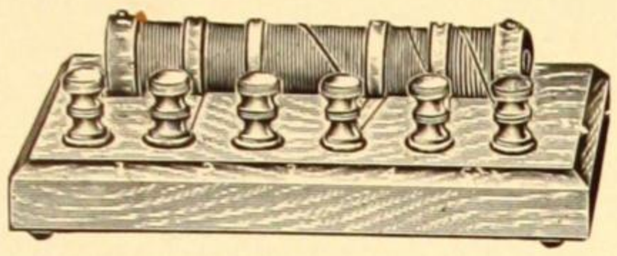
895E. Resistance Units. The wire in genuine Manganin—the only resistance wire having both a negligible temperature coefficient and no thermoelectric effect with brass or copper. Wound bifilar on wooden spools and thus free from inductance. Spools are finely finished and provided with binding posts as illustrated. Accuracy 1/10 of 1%.

Resistance, ohms....	1	2	5	10	25
Each **$2.50**		**2.75**	**3.00**	**3.50**	**4.00**
Resistance	50	100	200	500	1000
Each **$5.00**		**5.50**	**6.00**	**6.50**	**7.00**

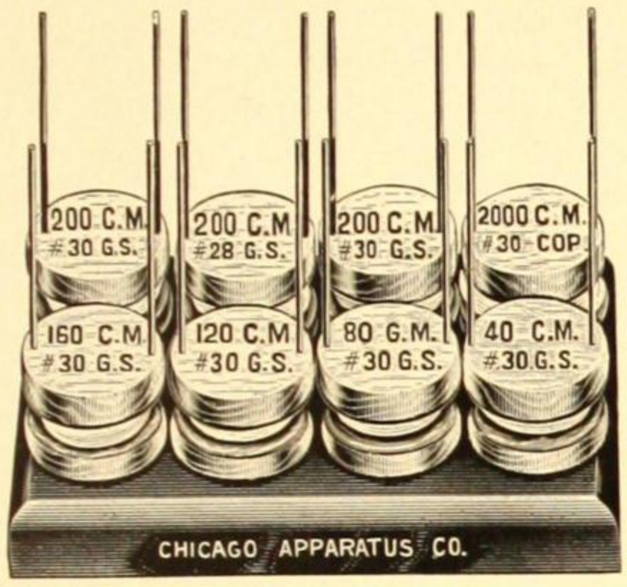
898E. Resistance Spools. Set of three. Spool No. 1 contains 5 meters No. 30 German Silver Wire; No. 2, 10 meters No. 30 German Silver Wire; No. 3, No. 36 German Silver Wire. This is an excellent set for comparing the resistance of coils with that of their lengths, as well as that of their cross-sectional areas. The spools are of porcelain, mounted on a 10x15 cm. hardwood base, with binding posts so that the coils may be separately or collectively measured **$3.00**

899E. Resistance Spools. Bifilar wound on wooden spools. Same type as used in Milvay Resistance Boxes. Heavy copper terminals. Accuracy 1/5%.

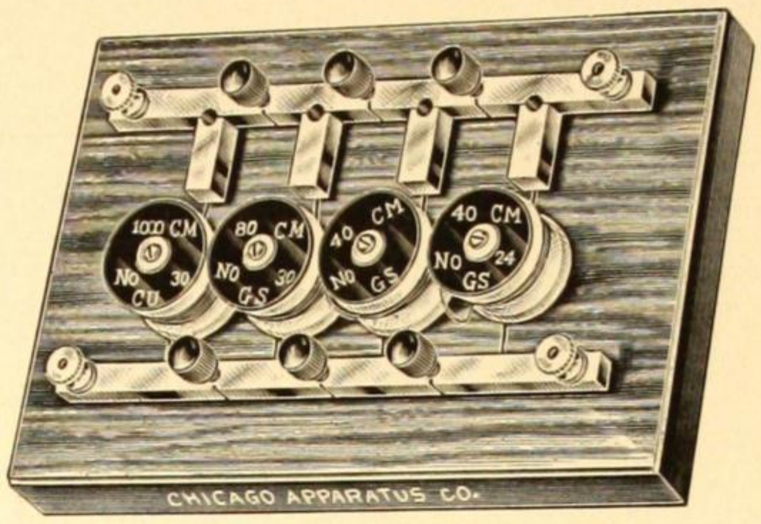
Resistance, ohms....	1	2	5	10	25
Each **$0.85**		**.90**	**.95**	**1.00**	**1.00**
Resistance, ohms	50	100	200	500	1000	5000
Each **$1.10**	**1.20**	**1.25**	**1.50**	**1.75**	**3.00**



No. 903E.



No. 908E.



No. 913E.

500 OHMS TO 5,000,000 OHMS



No. 914E.

903E. Resistance Spools. Set of five unknown resistances, the terminals of which are brought out to six large binding posts. The resistance of the coil may be measured separately or in series. Consists of the following spools: 10 Meters No. 22 Copper Wire; 10 Meters No. 28 Copper Wire; 20 Meters No. 22 Copper Wire; 20 Meters No. 28 Copper Wire; and 10 Meters No. 22 German Silver Wire. Complete, on 10x15 cm. finely finished wood base.....**$5.50**

908E. Resistance Spools. For use with Wheatstone Bridge. Eight separate spools and a 10x15 cm. wood base with pegs to hold spools when not in use. The terminals are of No. 14 gauge copper wire securely fastened to the spools and soldered, the ends of the resistance wires wound on the spools. This construction makes it easy to clamp the coils into the Wheatstone bridge gap; it also prevents the wires from breaking and therefore makes the coils more durable. Set consists of the following: 2 spools with 200 cm., 1 with 160 cm., 1 with 120 cm., 1 with 80 cm., 1 with 40 cm. No. 30 German Silver Wire, and 1 spool with 2000 cm. No. 30 Copper Wire.....**$5.00**

913E. Resistance Spools. Designed by C. H. Andrews of the South High School, Worcester, Mass. With four coils as follows: (1) 1000 cm. No. 30 Copper Wire, (2) 80 cm. No. 30 Copper Wire, (3) 40 cm. No. 30 German Silver Wire, (4) 40 cm. No. 24 German Silver Wire. The coils are permanently mounted, bifilar wound, and double insulated. The coils are so connected to the brass bars that different combinations may be secured by manipulation of the plugs, connecting any of the coils in series or parallel. As a result the following combinations are possible: 1. Two coils of the same diameter and material, but of different lengths. 2. Two coils of the same length and diameter, but of different materials. 3. Two coils of the same lengths and material, but of different diameters. Mounted on mahoganized hardwood base 15x22.5 cm., with rubber topped plugs.....**$9.00**

914E. Resistances, Super-Davohm (sold exclusively to educational institutions by the Chicago Apparatus Company). There has been great demand in the past for high resistances. This demand was met by the so-called metallic grid leak which was unsatisfactory in many respects owing to its wide tolerance of accuracy, usually 10% plus or minus the rated value.

The Super-Davohm Resistances, one-watt wire wound units, provide a resistance of greater accuracy. They are a wire wound high resistance unit having all the characteristics necessary to satisfy the most exacting demands. A few of the characteristics of these units are as follows:

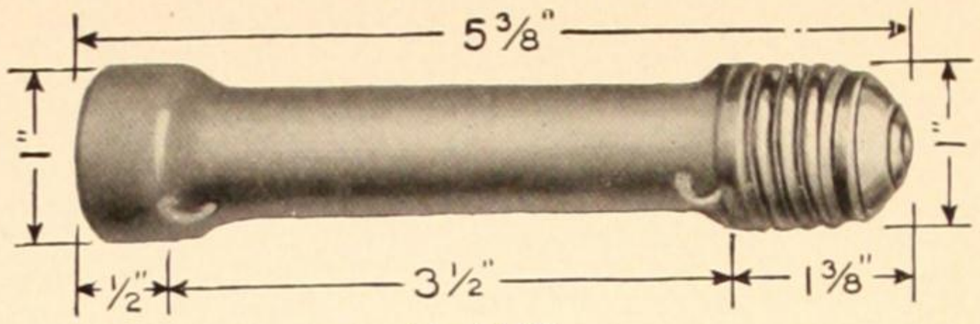
Practically negligible inductance.
Minimum distributed capacity.
Tolerance of accuracy 1% plus or minus.
Temperature coefficient .0001.
Safe load 1 watt.
Size 2 inches long, ½ inch diameter.

Because of their extreme accuracy and the above characteristics, they are especially recommended for use in the following:

As laboratory standard resistors.
Radio plate resistors.
Radio grid resistors.
High voltage regulators.
Telephone equipment.
Television.
Multipliers for voltmeters.
Isolation resistances in vacuum tube circuits.

Size No.	Resistance in Ohms	Each	Size No.	Resistance in Ohms	Each
(A)	10,000	**$1.50**	(I)	125,000	**$2.00**
(B)	15,000	**1.50**	(J)	150,000	**2.00**
(C)	20,000	**1.50**	(K)	200,000	**2.50**
(D)	25,000	**1.50**	(L)	250,000	**2.50**
(E)	35,000	**1.50**	(M)	500,000	**3.00**
(F)	50,000	**1.50**	(N) 1,000,000		**5.00**
(G)	75,000	**1.50**	(O) 2,000,000		**7.50**
(H)	100,000	**2.00**	(P) 3,000,000		**10.00**

NOTE: These resistances can be furnished in any values from 500 to 5,000,000 ohms. Prices on any size will be gladly quoted on request. They likewise can be furnished in closer tolerances than 1% at an additional cost. For accuracies of 1/5, 1/4 or 1/2 of 1%, add 50% to the prices listed above.



No. 915E.



No. 917E.

915E. Resistor Unit Plugs. Provided with standard Edison screw base to fit regular lamp sockets. Designed to replace incandescent lamps in lamp rheostats, lamp banks, load testing banks, battery charging banks, etc. They give better and longer service—they emit no light—they are not fragile—they are made in a wider range of resistances. Being completely covered with vitreous enamel, baked on at high temperature, they are practically indestructible and therefore the most economical in the end. Temperature coefficient is almost nil. Equivalents for 110-volt carbon lamps are as follows: 440 ohms resistor = 8 candle power lamp, 220 ohm resistor = 16 candle power lamp, and 125 ohm = (Approx.) 32 candle power lamp. Capacity for continuous duty, 60 Watts; for 20 seconds duty, 210 Watts. Be sure to specify size number of resistors wanted.

Size Number	Resistance, Ohms (Approx.)	Max. Carrying Capacity, Amperes	Volts at Max. Amp.	Each
1	1000	0.24	240	$2.00
2	700	0.29	203	2.00
3	440	0.37	163	2.00
4	350	0.41	143	2.00
5	220	0.52	114	2.00
6	125	0.69	86	2.00
7	90	0.81	73	2.00
8	62	0.98	61	2.00
9	45	1.15	52	2.00
10	22	1.65	36	2.00
11	12.5	2.2	27.5	2.00
12	10	2.4	24	2.00
13	7	2.9	20.3	2.00
14	5	3.5	17.5	2.00
15	3.5	4.1	14.3	2.00
16	2.5	4.9	12.2	2.00
17	1.2	7.1	8.5	2.00
18	0.6	10.00	6	2.00
19	0.4	12.3	4.9	2.00
20	0.2	17.3	3.5	2.00

917E. Resistor Units, Vitreous Enameled, Terminal Lug Type. In the laboratory these durable units have a wide field of application. They are unexcelled as fixed rheostats wherever close adjustment of current flow through a circuit is required, as series control resistors in relay, and cut-out circuits, as control units in experimental radio circuits, as current-draw units in loading banks, as unknown resistances in measurement work, as protective resistances in standard cell circuits, as shunts in galvanometer circuits, etc. To secure greater resistance values they may be connected into series. On the other hand larger current carrying capacities are obtainable by connecting the required number in parallel. Still greater flexibility is obtainable by placing suitable switches in the circuit so that units can be introduced in any desired series or parallel combination.

The resistances are not adjusted to exact values, but are held to within 5% of the rated values indicated below. The resistance of each unit is fixed and therefore unalterable. Nor does its value change in service because the wire employed has an extremely low temperature coefficient.

Each unit consists of a wire wound on a porcelain tube fitted with lug terminals and covered with a hard, dark brown, vitreous enamel fired on at a high temperature. This coating prevents shift of the wire; protects it against mechanical injuries, moisture and chemical fumes; provides maximum electrical insulation; and insures maximum heat dissipation. Further, the firing process ages the wire by relieving it of all mechanical strain, thus preventing the changes which would otherwise ensue.

The lugs are tinned and provided with $\frac{5}{32}$-inch holes for convenience in making either soldered or "screw-nut" connections. For convenience in panel, wall or board-mounting each unit is provided with steel brackets as illustrated. These brackets are readily removable and since the holes in the units go clear through, they can be mounted on pegs, bolts, or studs when desired.

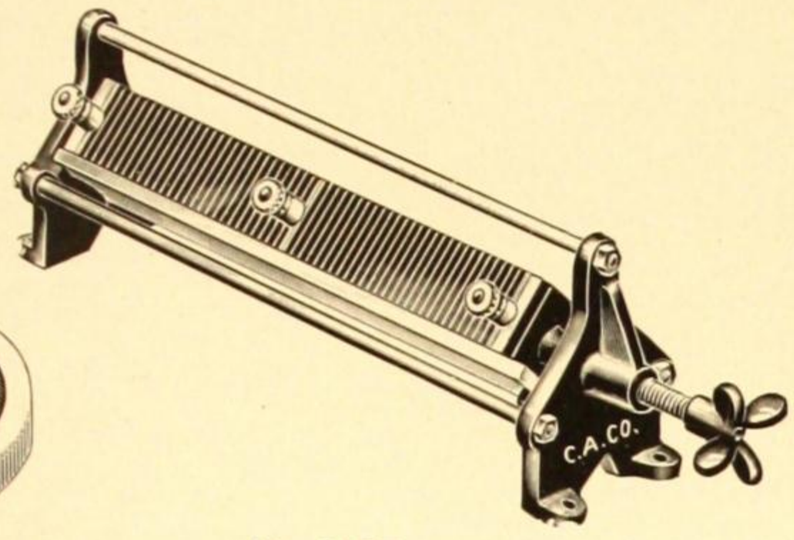
Length, 6½ inches; outside diameter, ⅞ inches; inside diameter ½ inch; capacity for continuous duty, 100 Watts; for 20 seconds duty, 300 Watts. Be sure to specify size number of units wanted.

Size Number	Resistance Ohms (+ or —5%)	Max. Carrying Cap., Amps.	Volts at Max. Amps.	Each
1	100,000	.03	3300	$2.75
2	60,000	.04	2500	2.50
3	40,000	.05	2000	2.50
4	30,000	.06	1666	2.25
5	20,000	.07	1430	2.25
6	10,000	.10	1000	2.00
7	4,000	.16	640	1.75
8	3,000	.19	570	1.50
9	2,000	.22	440	1.50
10	1,000	.33	330	1.50
11	400	.50	200	1.50
12	300	.60	180	1.50
13	200	.70	140	1.50
14	100	1.00	100	1.50
15	40	1.60	64	1.50
16	30	1.80	54	1.50
17	20	2.20	44	1.50
18	10	3.30	33	1.50
19	8	3.60	29	1.50
20	6	4.10	25	1.50
21	4	5.00	20	1.50

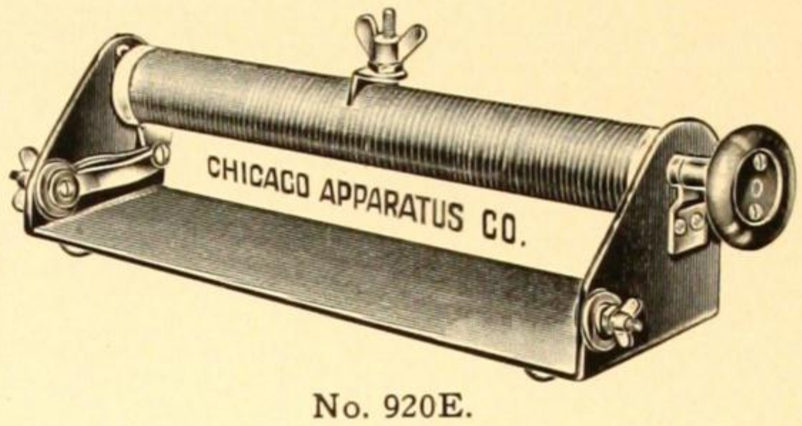
RHEOSTATS



No. 918E.



No. 919E.



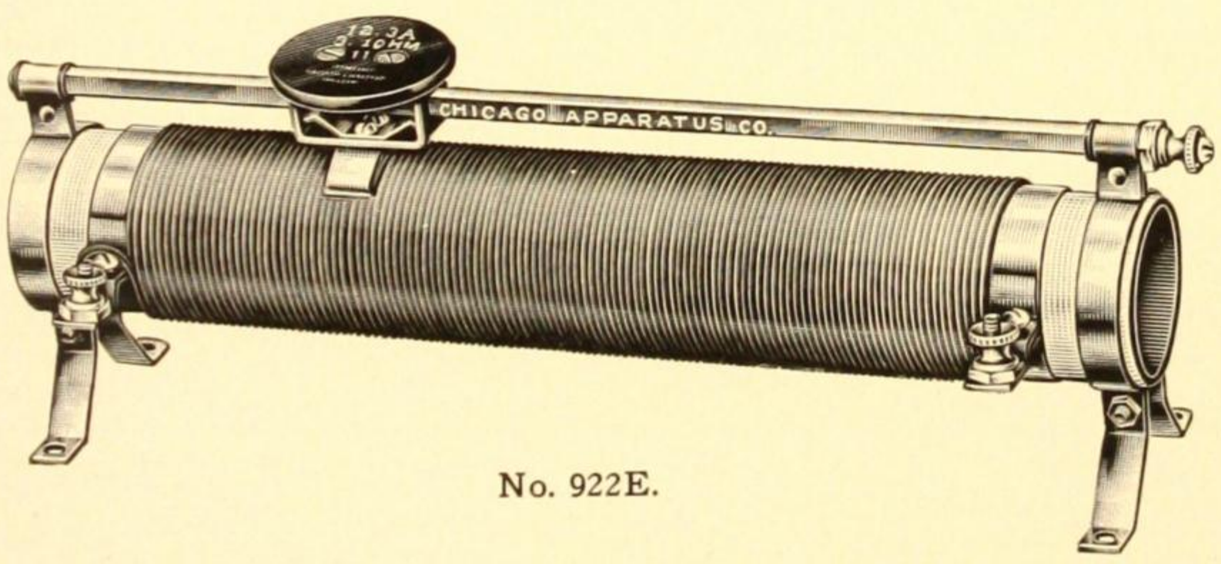
No. 920E.

918E. Rheostat, Battery. Suitable for regulating miniature lamps, the speed of small motors, etc. Change of resistance takes place very gradually by the movement of the lever over a resistance coil. Resistance of coil, 10 ohms; continuous capacity, 2 amperes. Mounted on a substantial base 3¾ inches in diameter **$1.75**

919E. Rheostat, Carbon Compression. The resistance element, a series of carbon blocks, is arranged in an asbestos slate trough so they can be compressed or released by means of wheel handle screw. Thus any value within the range—.06 to 6 ohms—is obtainable. Normal rating 250 watts. Suited for hard usage and will stand overloads of 1000 watts for short periods. Length 14½ inches, width 5¼ inches, height 6½ inches **$15.00**

920E. Rheostat, Graphite Compression. This new rheostat is of graphite compression type. It consists of a column of treated graphite discs mounted on an insulated rod, and offers the widest range in resistance, with more thermal capacity than any wire wound resistance unit or units made up from carbon plates. Carbon does not have the thermal capacity of graphite. Normal capacity, 200 watts; but will stand 500 to 1000 watts under momentary loads. The maximum resistance (all pressure released) is 100 ohms; the minimum resistance (under full compression) is 1 ohm. By shifting the auxiliary terminal and using 1/10 of the column of discs under full pressure, a reading as low as 1/10 of an ohm may be obtained. Maximum capacity, 40 amperes continuously; suitable for use on either A.C. or D.C. circuits up to 250 volts; portable and may be used in either a vertical or horizontal position, or attached underneath a bench in an inverted position. Length 15½ inches, height 4¾ inches, width 3¾ inches **$17.50**

Milvay Slide Wire Rheostats



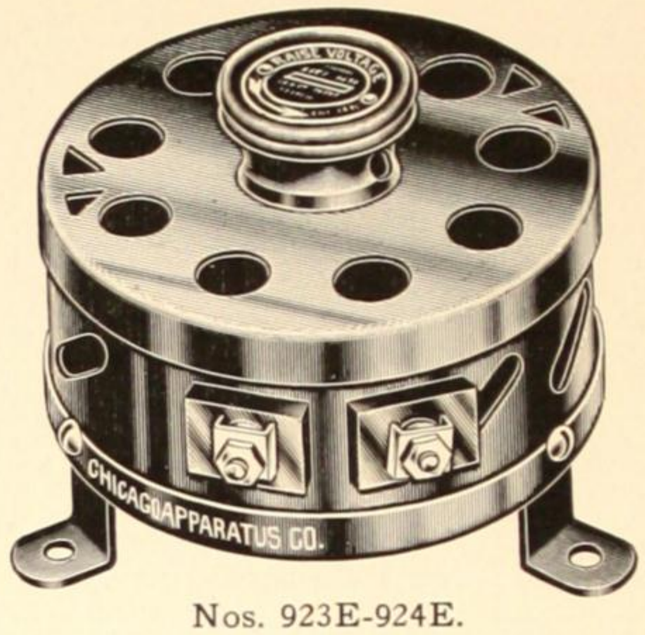
No. 922E.

922E. Rheostats, Milvay Laboratory.

Larger capacity and smoother action characterize these new Milvay rheostats. The adoption of a new standard for tube length—325 mm.—made the larger capacity—450 watts continuous service—possible. This new tube length also provides sufficient end space to enable the contact slider to reach the very extremes of the resistance element, giving to every Milvay rheostat a wider and larger resistance range.

The resistance element is machine-wound under even tension, the slider is laminated and all parts are precision-made by special tools. This gives to Milvay rheostats a new smoothness of adjustment and a new evenness of contact.

The resistance element is made from a special alloy having a low temperature coefficient and coated with a thin film of oxide which gives ample insulation against the small potential difference between adjacent turns. There is no empty space between turns, thus giving the greatest possible resistance range for the physical dimensons of these rheostats. The wire is wound on white porcelain-enameled



Nos. 923E-924E.

Milvay Slide Wire Rheostats—Cont.

steel tubes which insure a maximum dissipation of heat.

The capacity of all rheostats for continuous duty is 450 watts; for short intervals, 550 to 600 watts.

In the table below we indicate the highest voltage which may be safely applied to each rheostat when the maximum resistance is included in the circuit. From this table it is obvious that rheostats Nos. 1 to 6 may be used on 220-volt circuits and Nos. 1 to 8 on 110-volt circuits.

All four legs of each rheostat are provided with screw holes for permanent board or panel mounting. By standardizing on a single tube length and diameter—325x50 mm.—we are able to effect manufacturing economies of sufficient importance to enable us to sell these high-class rheostats at the extremely low prices given below:

Size No.	Approximate Resistance, Ohms	Maximum Amperes	Maximum Voltage	Each
00	6140	.25	1535	**$8.00**
0	4260	.30	1278	**7.00**
1	2962	.39	1155	**6.00**
2	1570	.54	848	**6.00**
3	797	.75	598	**6.00**
4	381	1.1	419	**6.00**
5	198	1.5	297	**6.00**
6	97	2.2	213	**6.00**
7	56.5	2.8	158	**6.00**
8	27	4.1	111	**6.00**
9	18	5.0	90	**6.00**
10	6.5	8.3	54	**6.50**
11	3.1	12.2	38	**7.50**

Water Cooling

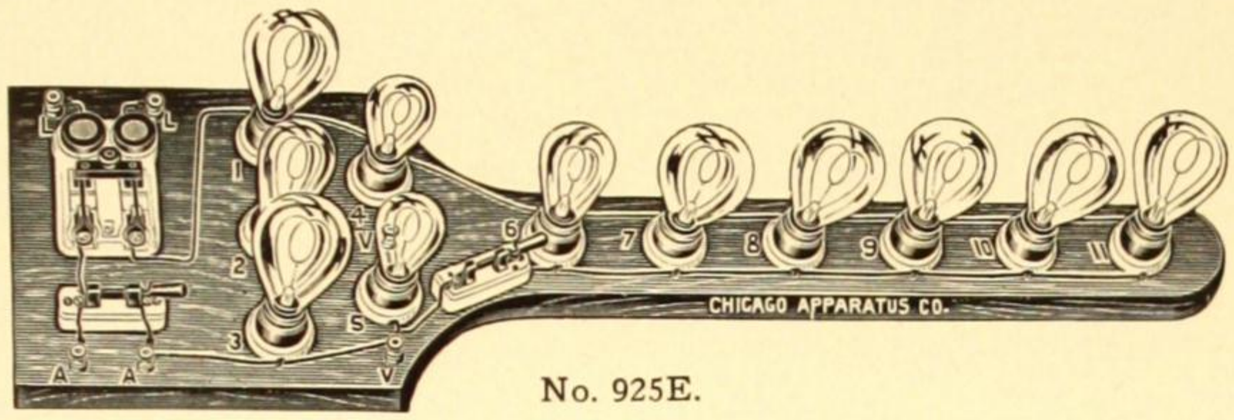
By inserting a one-hole stopper provided with a short glass or metal tube for rubber tubing connection in each end of the rheostats water may conveniently be circulated through them. This doubles the dissipation of heat, thereby doubling the capacity. By this method all Milvay rheostats may be used for either water-cooled or air-cooled service, at no additional cost or investment.

923E. Rheostats, National. Advantages which make these inexpensive, variable rheostats ideal for laboratory use are: Fine regulation with as many points of control as there are turns of wire providing a gradual increase or decrease of current; quiet operation; small size, light weight, all-steel enclosed and protected; copper-nickel alloy resistance element, no iron to rust, no zinc to oxidize; perfect ventilation, beautiful design and finish. Legs have screw holes for permanent mounting on board or panel. Diameter, 4½ inches; height to top of case, 3 inches; weight, 1¼ pounds. In ordering be sure to specify size number wanted.

Size number ...	1	2	3	4	5	6
Approximate resist., ohms..	5	10	20	32	40	80
Maximum amps. (all resist. out)	6.4	4.0	2.5	2.0	1.25	1.0
Minimum amps. (all resist. in).	3.2	2.0	1.0	0.8	0.5	0.5
Each	**$5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**

924E. Rheostats, National. Same as No. 923E, but larger. Diameter, 9 inches; height to top of case, 5 inches; weight, 5½ pounds. In ordering be sure to specify size number wanted.

Size number ...	1	2	3	4	5	6
Approximate resist., ohms...	5.3	20	75	400	800	1920
Maximum amps. (all resist. out)	15	7.5	4.0	1.5	0.75	0.5
Minimum amps. (all resist. in)..	7.5	3.75	2.0	0.75	0.38	0.2
Each **$11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**



No. 925E.

New Milvay Lamp Rheostat

925E. **Rheostat, Lamp, Milvay Improved Design, Complete With Lamps.** For controlling incandescent lighting circuits and for demonstrating the laws of series and multiple combinations a Lamp Rheostat is indispensable. The models heretofore offered for this purpose have a number of disadvantages. They do not permit current control in uniform steps. The different lamp combinations required to secure various currents are too complicated. The circuits are too elaborate and, therefore, difficult to trace. This new Milvay Rheostat—the result of considerable experimental and research work—entirely overcomes these objections and offers an extremely simple device that controls current in uniform steps—that is very easy to manipulate and that has circuits which can be quickly and easily traced.

SPECIFICATIONS

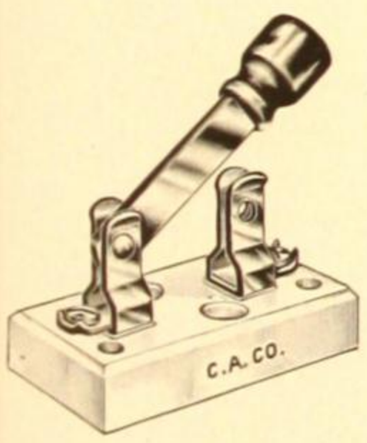
Range. 1/10 to 5.5 Amperes in steps of 1/10 Ampere. No rheostat offers such a wide range or such uniform control.

Connections. These are made and broken by turning the lamps in their sockets. This is rapid, easy and convenient. A special knife switch, provided for cutting out the larger lamps, enables instant change from large to small currents.

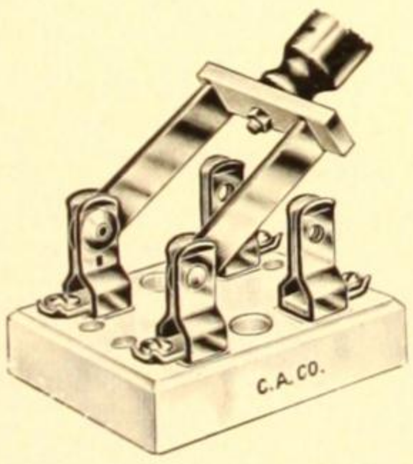
Instrument Posts. Conveniently located binding posts are provided for voltmeter and ammeter connections with a short circuiting switch for the ammeter.

Fuse Protection. The line connections are provided with fuses and all wiring is insulated, thus affording the fullest protection.

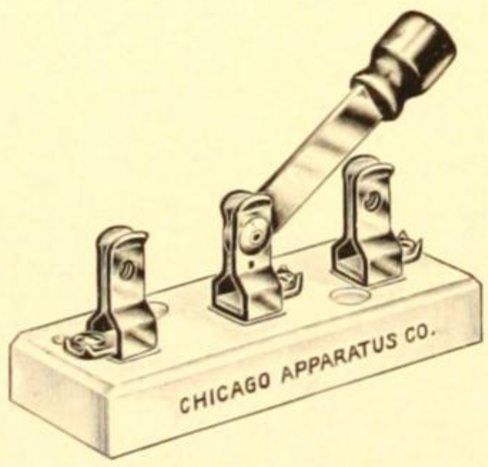
For use on either 110-volt A.C. or D.C. circuits, **complete with eleven lamps,** blue print, and full instructions **$20.00**



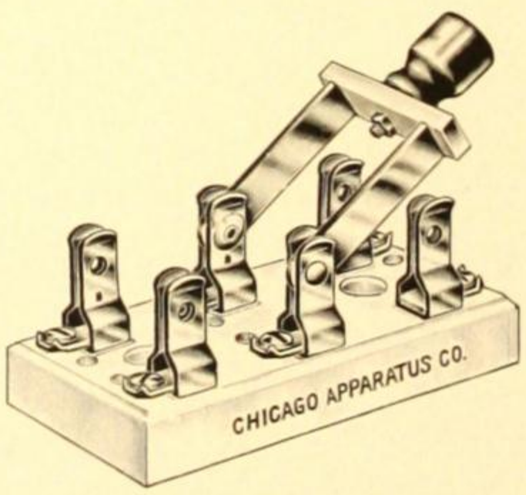
No. 929E.



No. 930E.



No. 931E.



No. 932E.

KNIFE SWITCHES

White porcelain bases, heavy copper parts, 25 ampere carrying capacity.

929E. **Switch, Knife, Single Pole, Single Throw.**
Base 3x8 cm. **$0.35**

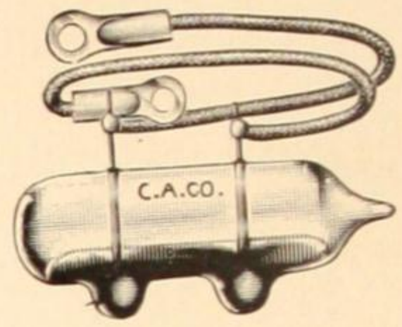
930E. **Switch, Knife, Single Pole, Double Throw.**
Base 3.5x10 cm. **$0.50**

931E. **Switch, Knife, Double Pole, Single Throw.**
Base 5x6.5 cm. **$0.55**

932E. **Switch, Knife, Double Pole, Double Throw.**
Base 6.5x10 cm. **$0.75**



No. 933E.



No. 937E.

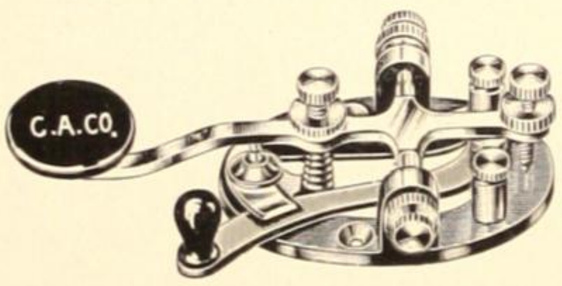
933E. Switches, Wood Base. Nickel-plated lever and contact points. Diameter, 63 mm.

No.	A	B	C
Contact points	1	2	3
Each	$0.23	.25	.50

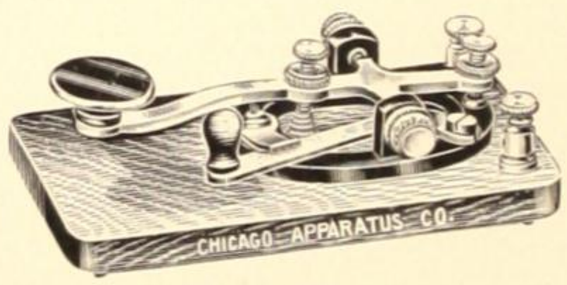
Mercury Switch

937E. Switch, Mercury-in-Glass. For opening and closing A.C. and D.C. circuits. Commercially this type is employed in the control circuits of timing, oil burner, refrigerator and other automatic devices. In the laboratory, arranged so it can be tilted 15 to 20 degrees, it forms a more reliable contactor than a metallic key. Also it is useful in the distant control of apparatus by cord or other method. The switch is different from others of the mercury type. The construction is such that during normal operation the electrodes always remain immersed in mercury, some of which stays in the cups or depressions even during and after "break." The result is mercury to mercury make and break and not mercury to electrode make and break as in older forms. For this reason this switch is more dependable and more durable. Laboratory tests show upwards of 200,000 perfect makes and breaks without noticeable deterioration. Approximate length, 2 inches; diameter, ¾ inch; power rating, 200 watts; maximum voltage, 220 volts; maximum carrying capacity, 10 amperes. Has 6-inch leads with ring terminals..... $3.00

Telegraph and Telephone Instruments



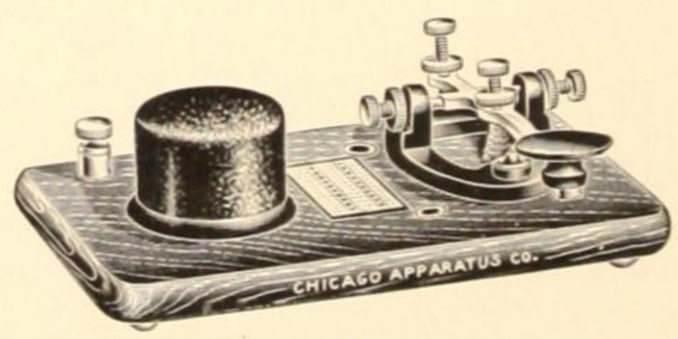
No. 938E.



No. 943E.



No. 948E.



No. 970E.

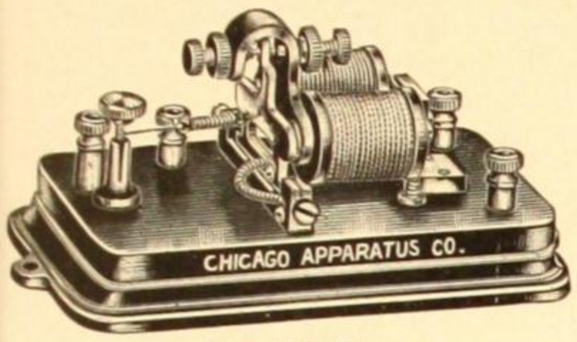
938E. Telegraph Key. Standard form. Same as used by telegraph companies. Nickel-plated steel lever with solid trunnions. Brass frame with screw holes for mounting. Fitted with improved spring holder $2.75

943E. Telegraph Key, Students'. Practical and serviceable on any telegraph circuit. Nickel-plated lever with solid trunnion. Japanned key base, mounted on hardwood base. May be easily dissected for reassembling by students $2.25

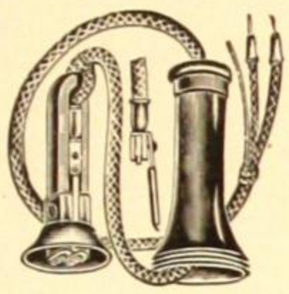
948E. Telegraph Key and Sounder. On one base. The sounder magnets, lever, anvil and key lever are the same as in instruments Nos. 943E and 968E. A first-class instrument that will give entire satisfaction on lines up to five miles in length. Mounted on polished hardwood base $4.00

953E. Telegraph Relay. Standard Pony Relay. Its use will enable work on lines up to 20 miles in length to be done with perfect ease. Extremely sensitive; responds to very small currents. Metal parts are nicely finished and lacquered, mounted on hardwood base $4.50

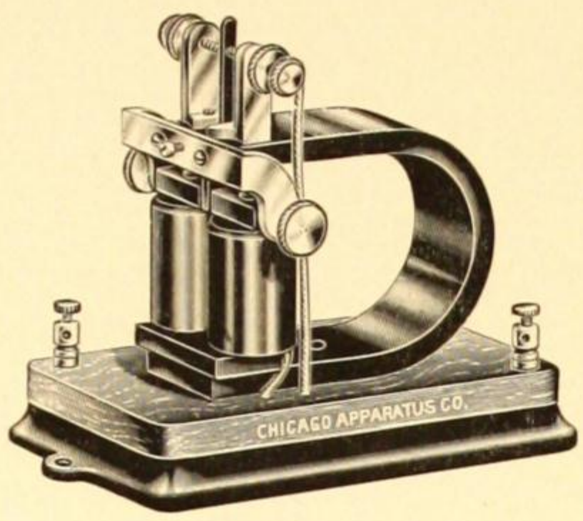
Telegraph and Telephone Instruments—Cont.



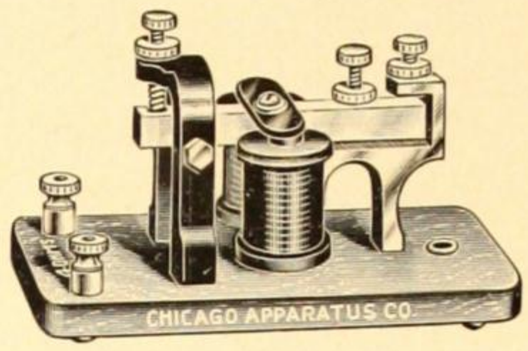
No. 953E.



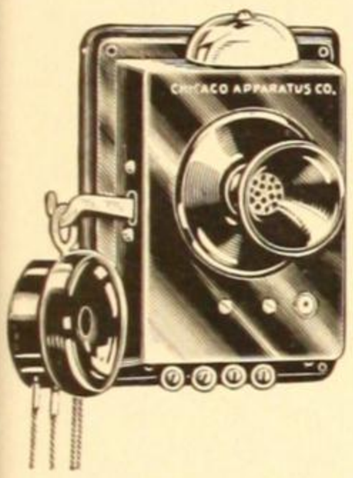
No. 978E.



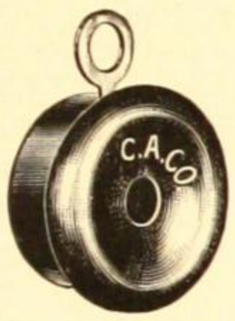
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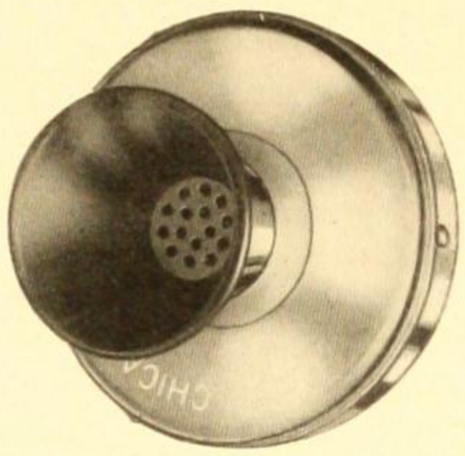
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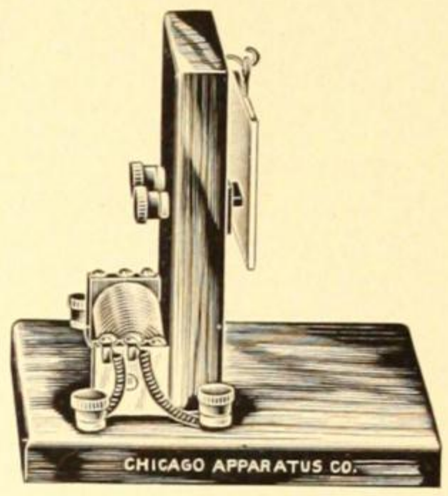
No. 973E.



No. 983E.



No. 988E.



No. 990E.

955E. **Telegraph Relay, Polarized.** Type used in long distance telegraphy. Far more sensitive than No. 953E. Responds to minute currents because armature is finely balanced in a combined permanent and electromagnetic field. Resistance, 50 ohms. **$22.00**

968E. **Telegraph Sounder.** Resistance, 4 ohms. Operates on any battery circuit of from 1 to 2 volts. May easily be dissected for re-assembling by students **$3.00**

970E. **Telegraph Code Practice Set.** For use in teaching and practicing transmission and reception of code by the "sound" method. Trains students to immediately and instinctively translate dots and dashes into the letters for which they stand. Consists of a telegraph key and a high frequency buzzer secured to a common base with the wiring brought out to three binding posts. The characters of the international Morse Code are contained on a metal plate fastened to the base. One set, operated on two dry cells, is needed for demonstration or self-instruction. Two sets, operated on four dry cells, are required for intercommunication. All metal parts are finely finished and mounted on polished 17x11 cm. wooden base. With 14-page booklet containing complete information about the code, best methods of practice and hook-up details **$3.40**

973E. **Telephone, Battery Call.** This telephone is intended for use on lines up to 4000 feet in length. Operates on a battery circuit of two dry cells per station. Both transmitter and receiver—watch case type—are very sensitive. Each phone has a bell for signal purposes and a push button mounted on the lower right hand corner of the case. Price per station, wiring diagram and full directions..... **$8.00**

978E. **Telephone Receiver.** Demonstration form. Easily dissected for demonstration purposes. Latest two-pole type. As used on modern telephone systems. Can be used on any line—local or long distance. Complete receiver and cord..... **$2.25**

983E. **Telephone Receiver. Watch Case Form.** Diameter, 2¼ inches; weight, 6 ounces; resistance, 75 ohms. The adjustment is rigid and will not become changed even by the greatest carelessness. Ideal for instrument use and laboratory testing..... **$1.50**

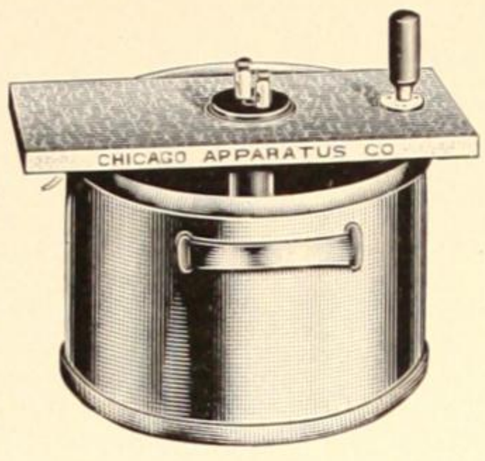
988E. **Telephone Transmitter.** Standard long distance type. Articulates distinctly and plainly. Easily taken apart for inspection. Consists of carbon cell, carbon grains and metal diaphragm enclosed in nickel-plated case provided with a composition mouthpiece **$3.00**

990E. **Telephonic Microphone, Fountain's.** Designed by Dr. C. R. Fountain, Peabody College for Teachers, Nashville, Tenn.

A simple instrument for demonstrating the principles of: (1) simple microphone, (2) telephone transmitter, (3) telephone induction coil, and (4) telephonic intercommunication. The demonstrations are easily made as follows: (1) Two dry cells and telephone receiver (like our No. 978E) are connected in series to the two binding posts on the upright. The tick of a watch lying on the base or the impact of a pith ball falling on the base are clearly heard in the receiver—an excellent demonstration of the action of the simple microphone. (2) With the same connections as above, but employing extra long wires or cords so that the receiver may be removed 25 to 50 feet, the speaking voice impressed on the suspended diaphragm is clearly heard in the receiver, thus demonstrating transmitter action. (3) Connecting two dry cells and primary of coil in series to the two binding posts on the upright and the receiver to the terminals of the secondary of the coil, the voltage of the current in the receiver circuit is raised. A louder tick, impact, or voice is heard in the receiver as a result. (4) If two microphones and receivers, placed in rooms separated by 25 to 50 feet, are hooked up, intercommunication is possible. The diaphragm is removable, and the primary and secondary terminals are plainly marked; thus all constructional details can be studied and all circuits readily traced.

Mounted on 17.5x17.5 cm. base and furnished with complete directions **$8.50**

Note: For simple microphone, without Induction Coil, see page 104.



No. 992E.



No. 993E.

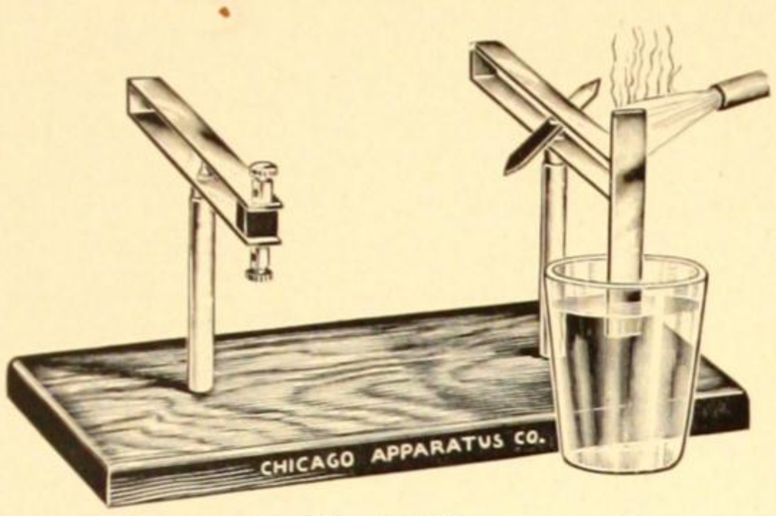


No. 994E.

992E. Temperature Coefficient Apparatus, Milvay. For determining the temperature-resistance coefficient of a copper conductor as per experiment No. 6 (page 72) in Millikan and Mill's "Electricity, Sound and Light." The water heating tank is of heavy copper and measures 21 cm. in diameter by 15 cm. high. The cross bar which supports the brass calorimeter and coil is heat-proof, water-proof and warp-proof. It is held securely in position by spring clamps which engage the wired top edge of the tank. This rigid construction makes stirring safe and easy, yet permits instant removal for filling, emptying, and cleaning of tank. The copper wire, the temperature-resistance coefficient of which is to be determined, is non-inductively wound in shift-preventing grooves on a heat, water and warp-proof composition cylinder. It is supported by a cover of the same material within a thin brass calorimeter. Heavy copper wires pass from the coil through the cover to binding post terminals. Cover is provided with center opening for insertion of thermometer. Coil resistance at ordinary temperature is about 4 ohms and at 100° C. about 5 ohms—a larger ohmic change than is usually found in apparatus of this kind. A simple, easy-acting, effective stirrer completes the outfit. Without thermometer **$17.50**

993E. Temperature Coil, New Milvay Design. Resistance at 15° C. about 4.1 ohms and at 100° C. (boiling water temperature) about 5.1 ohms—a more pronounced ohmic change than that which occurs in old low-resistance types. The wire naturally expands considerably when heated to 100° C., and when wound on a plain tube it loosens and side-shifts, causing short circuits which result in errors or burnouts. This cannot happen in the Milvay, because the wire is laid in deep grooves. The winding is bifilar to prevent inductive effect. The hollow tube, 15 cm. x 25 mm., is a special composition that is proof against heat, water, warpage, and breakage. Extra heavy copper terminals 21 cm. long. For quantitative determination of the temperature resistances coefficient of copper wire, and lecture demonstrations of the effect of temperature on the resistance of a conductor, this new Milvay product is a distinct advance over older types..... **$2.25**

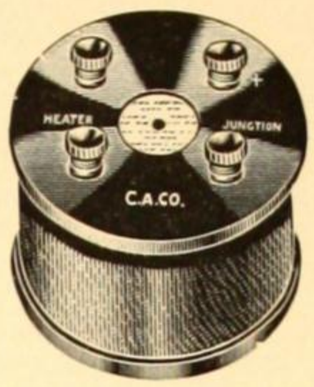
994E. Temperature Coil, 50-Ohm. For use in measuring the temperature coefficient of resistance by the kerosene immersion method as outlined in Exp. 28, "General Physics for the Laboratory," by Taylor-Watson-Howe. Consists of copper wire having both enamel and silk insulation cross-wound on a skeleton-type bakelite bobbin to insure maximum contact between wire and liquid. The ends of the wire are soldered to heavy metal terminals mounted on the bakelite bobbin and fitted with low-resistance copper lead-in wires, 50 cm. long by 3 mm. diameter. The resistance at room temperature is about 50 Ohms and at 100° C. about 60 ohms. A high grade coil for exacting work **$6.00**



No. 998E.



Couple in Glass Bulb only of No. 1000E.



No. 1000E.

998E. Thermo-Electric Needle. For demonstrating the properties of a thermo couple and for measuring the current flow in a thermo couple circuit by the substitution of a test circuit. Consists of a thermo couple circuit and a test circuit mounted on pillars attached to a common base, as illustrated. In the center of each circuit is a pivot for receiving a magnetic needle. The thermo couple circuit consists of two dissimilar metals, copper and an alloy of nickel, joined together to form a complete metallic circuit of rectangular shape. A short section of the copper circuit projects upward from the "Hot" junction; while a somewhat longer section extends downward from the "Cold" junction. The second, or test circuit, is entirely of copper and of exactly the same dimensions as the copper portion of the first circuit. Obviously, it has the same resistance. It is an open circuit with binding post terminals, the nickel alloy being replaced with short block of insulating material.

The general procedure in demonstrations with this apparatus is as follows: Place the apparatus so that the long diameter of the base is in an east-west position. Rotate the thermo couple and test circuits in their pillars into a north-south position. See that the nickel alloy section of the thermo couple and the binding posts of the test circuit are towards the south. Place the needle on the pivot in the thermo couple circuit. Press the thumb and forefinger against the copper strip, which projects upward. A slight deflection of the needle will take place. Next apply a flame from a Bunsen or other burner to this same section. A larger deflection will take place. Immerse the lower copper strip in cold water contained in a tumbler and again apply the flame to the upper strip. A still larger deflection will take place. The above clearly illustrates that heating the junctions of these two dissimilar metals causes the flow of an electric current, and that the larger the difference between the temperatures at the "Hot" and "Cold" junctions, the greater will be the current flow. With the lower copper strip dipping in cold water, again heat the upper strip. Note that the north pole of the needle will deflect to the west or left.

According to the right hand rule governing the deflection of a magnetic needle, the current flow in the copper section of the circuit if from the "Hot" to the "Cold" junction. Therefore, the flow in the nickel alloy is from the "Cold" to the "Hot" junction. To verify this, transfer the magnetic needle to the test circuit and so connect a dry cell to this circuit that the needle will deflect in the same direction as before. Trace the direction of current flow, which should be as explained above.

Remove the cold water and now heat the lower instead of the upper strip. The current flow is now in the reverse direction as the deflection of the needle will show.

The amount of current flowing under a certain condition in the thermo electric circuit can be measured by the following method: Immerse the lower copper strip in cold water contained in a tumbler. Heat the upper strip and note the deflection of the needle, which, if a Bunsen flame is used, will be about 45°. Transfer the magnetic needle to the test circuit and cause sufficient current to flow through this circuit to produce the same deflection. Measure the current flow with an ammeter. It will be about 5 amperes. Since the resistance of the test circuit is the same as the thermo couple circuit. It follows that the current flowing in the thermo couple circuit under the above conditions, was the same as that flowing in the test circuit; namly about 5 amperes. The presence of iron will disturb the magnetic needle; hence, the Bunsen burner employed should be of a type like our No. 426C, which contains no iron in its construction.

The apparatus is sturdily built and mounted upon a finely finished, 10 x 30 cm. hardwood base. Complete, with one magnetic needle of the bar type. **$8.00**

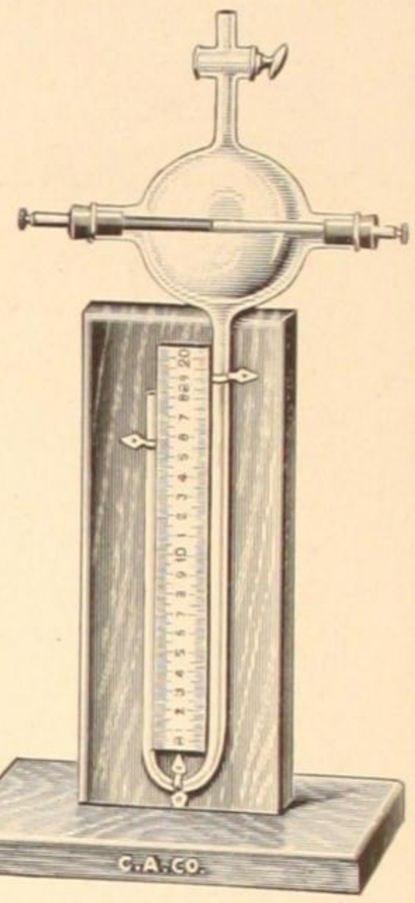
1000E. Thermocouples in Vacuo.

The measurement of current in terms of heat developed has long been recognized as the best method of determining the true root-mean-square (R. M. S.) values of alternating currents. This method has been taken advantage of to the highest degree in the development of these couples. With them, both D.C. and A.C. currents of any frequency, including radio frequencies, can be measured with accuracy. They can be checked on direct current, and used without correction on radio frequencies. The essential working element of these thermocouples is the junction of two dissimilar metals at the center of a heater wire or strip which carries the current desired to be measured.

The heat developed generates a small E.M.F. at the junction which is unidirectional in character and readable on a sensitive D.C. Millivoltmeter or Microammeter. The couples are mounted in an evacuated glass bulb, all four leads being brought to the outside.

Features which characterize these couples are: Constancy of calibration, Low temperature coefficient, High sensitivity, Freedom from error due to frequency, Minimum lag. Each couple is mounted in a neat case carrying rating plate and marked binding post terminals. For general laboratory use this mounted form is far superior to the unmarked, unprotected, and unmounted type.

No.	A	B	C	D	E	F	G
Normal range, milliamps.	2	5	10	50	100	200	500
Safe heater current, milliamps	4	10	15	65	130	250	600
Approximate heater resistance, ohms	750	150	30	5	1.5	1	0.5
Approximate voltage on junction, millivolts	7	7	7	7	7	7	7
Each	**$16.50**	**16.50**	**16.50**	**16.50**	**16.50**	**16.50**	**16.50**

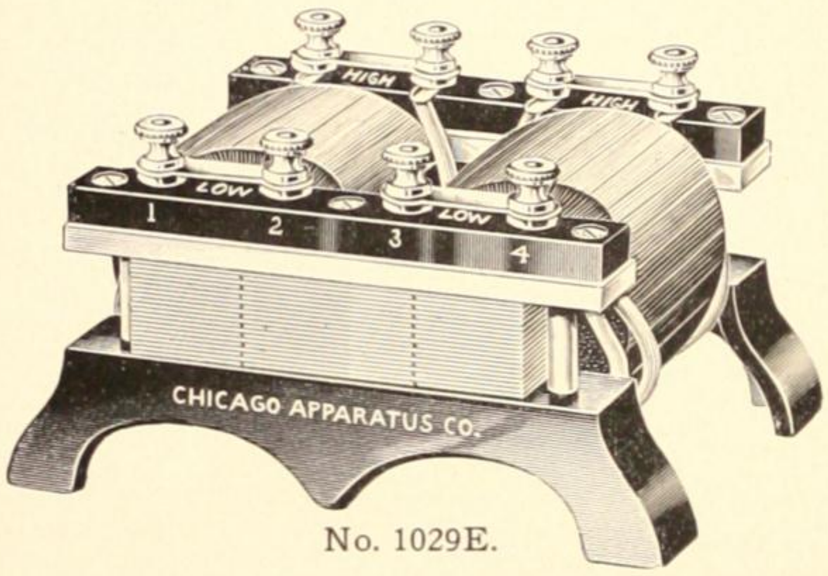


No. 1005E.

1005E. Peltier Effect Apparatus. For showing that the junction of an antimony-bismuth couple is heated when the direction of current flow is from bismuth to antimony, and cooled when the flow is in the opposite direction. The antimony-bismuth couple is mounted in a glass bulb connected with a U-shaped manometer and stopcock tube as illustrated.

In use, a colored liquid is introduced into the manometer and the liquid in both arms allowed to reach the same level by opening the stopcock for an instant. About 5 amperes of direct current are then caused to flow through the couple. If the direction of flow is from bismuth to antimony, the air in the bulb will expand, causing a depression of the liquid in the right arm of the manometer, indicating the liberation of heat at the junction. If the current flow is reversed, the opposite effect ensues, indicating cooling at the junction. On finely finished wooden support with manometer scale graduated in millimeters.....**$13.50**

Transformers



No. 1029E.

1029E. Transformer Model, MILVAY. The design of this new model fully meets every requirement of the educational laboratory, yet in constructional detail it conforms strictly to the best commercial electrical engineering practice. The results are:

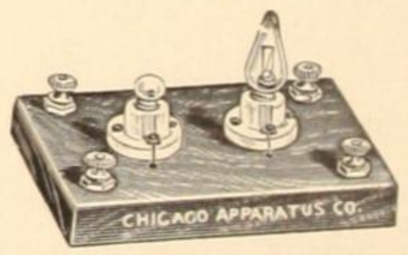
1. Full exposure of core, coils, terminals and other parts for inspection and study of transformer design.
2. Maximum stability and utmost convenience for making and changing circuit connections.
3. Cool operation even under conditions of maximum load and continuous service.
4. Maximum efficiency under all conditions of service.
5. Equally satisfactory performance on all frequencies from 25 to 60 cycles.

The primary coils each contain 336 turns on No. 18 B & S gauge insulated copper wire, the secondaries each 84 turns No. 12 B & S gauge insulated copper wire. These gauges are heavier than those usually employed on transformers of this type and since their current-carrying capacities are far greater the efficiency under all load conditions up to maximum, obviously is also greater.

The cross-sectional core area is also very large —28x28 mm. This insures maximum electromagnetic action, low core losses, and, therefore, a minimum generation of heat. Furthermore, no bolts pass through the core laminations to short circuit them. Hence, the flow of the eddy currents is kept in the plane of the laminations where they cannot interfere with the action of the transformer.

The terminals of all four coils are brought out to separate, marked binding posts. This, with the four connecting links supplied, makes it possible to arrange the transformer to illustrate three distinct types: 1. As a step-up transformer for changing high to low voltages. 2. As a step-down transformer for changing high to low voltages. 3. As an auto transformer for changing voltages up or down by the method of divided windings. Furthermore, the coils can be connected into series or parallel.

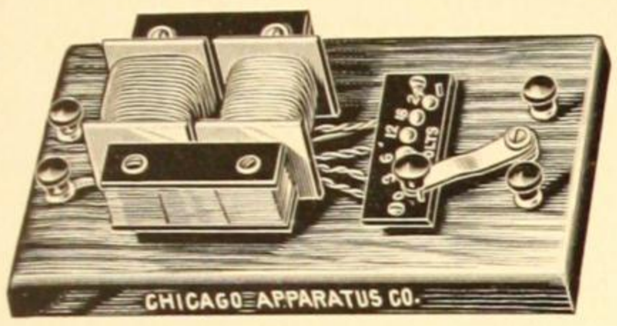
The low winding coils will stand 15 volts when used singly or in parallel and 30 volts when in series. The high winding coils will stand 60 volts when used singly or in parallel and 120 volts when in series. Current carrying capacity of the low winding coils is 6 amperes and of the high winding coils, 1.5 amperes. Thus the maximum capacity for continuous service is 180 watts. Considering the foregoing facts, this new MILVAY Model Transformer offers the utmost value in design, construction and performance. With complete directions.....**$15.00**



No. 1030E.

1030E. Set of Transformer Lamps. Used with No. 1029E gives visible proof of voltage transformation. The candle power of both lamps is the same, but the voltage of one is four times the other. On 10x15 cm. hardwood base, with binding posts.....**$3.50**

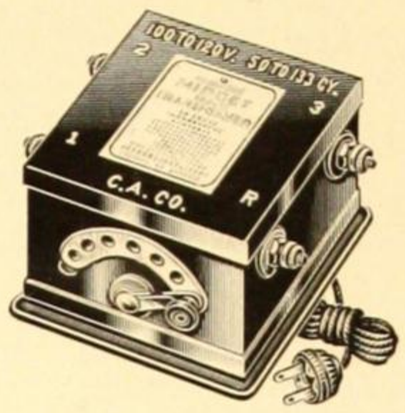
Transformers—Cont.



No. 1031E.



No. 1032E.



No. 1033E.

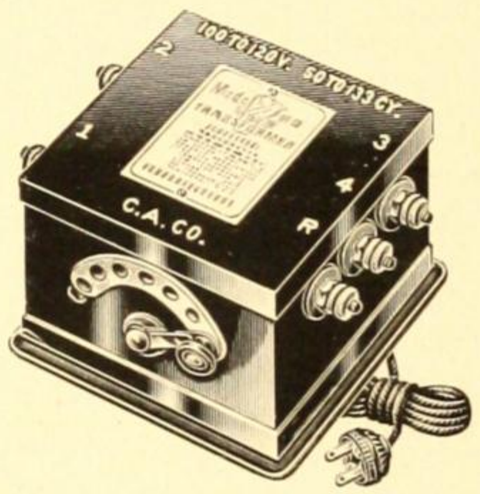
1031E. Milvay Tap-Type Demonstration Transformer. Transformers with voltage taps as illustrated and described in our catalogue under Nos. 1033E, 1034E and 1038E are among the most popular types in use for the operation of small electrical devices of all kinds—either A.C. or D.C.—including induction coils, motors, small lamps, etc. Inasmuch as these transformers are entirely enclosed in a sealed sheet metal case, their internal construction and wiring cannot be revealed and studied. While of great practical value, they are of insufficient educational value. For this reason we have designed the new transformer illustrated above. It reveals the internal construction and wiring of the popular tap-type transformer. The core, coils, wiring, taps and regulating lever are fully exposed so that every detail can be studied and all circuits traced. The manner in which the different secondary voltages are tapped off at the secondary coil is clearly revealed. The taps are five in number and yield 3, 6, 12, 18 and 24 volts. This new MILVAY product is more than a mere demonstration instrument. The construction is so substantial that it may be used for continuous duty within the limits of its capacity, the same as any commercial transformer. It is designed for use on 100 to 125-volt, 60-cycle, alternating current circuits. Capacity, 75 watts. Extra large core, 4x3x1 inches. Base size, 6x10 inches. We can highly recommend this new model for the laboratory study of transformer design, construction, and operating efficiency **$10.00**

1032E. Transformer, Bell Ringing, Tri-Volt. Provides three secondary voltages—6, 12 and 18 volts. For direct operation from 110 volt, 60 cycle A.C. circuits. Will operate one to five 2½ or 3 inch bells. Capacity, 25 Watts. Size, 2x2½x3⅞ inches. Weight 1 lb. **$1.50**

1032Ea. Transformer, Bell Ringing, Tri-Volt. Same as No. 1032E, but for use on 110-volt, 25-cycle A.C. circuits **$2.00**

1033E. Transformer, Laboratory. For use directly on 110 volt A.C. lines to furnish low-voltage currents for the operation of small electrical apparatus of all kinds—either A.C. or D.C.—including induction coils, motors, small lamps, bells, buzzers, etc. Binding posts terminals provide permanent voltages of 4.5, 9 and 13.5 volts, all of which can be used simultaneously. A voltage regulator provides 25 additional voltages ranging from 5.5 to 23 volts in ¾-volt steps, making the use of a rheostat unnecessary. Terminals and regulator positions are numbered, and an attached plate indicates terminals and regulator position to use to secure any desired voltage. Coils and core are completely imbedded in a solid block of insulating compound enclosed in a black-enameled metal case, with cord and plug. Size, 5x4x3¾ inches. Capacity, 100 Watts. For use on 110-volt, 60-cycle A.C. circuits **$5.50**

1033Ea. Transformer, Laboratory. Same as No. 1033E, but for use on 110-volt, 25-cycle A.C. circuits **$7.00**



No. 1034E.

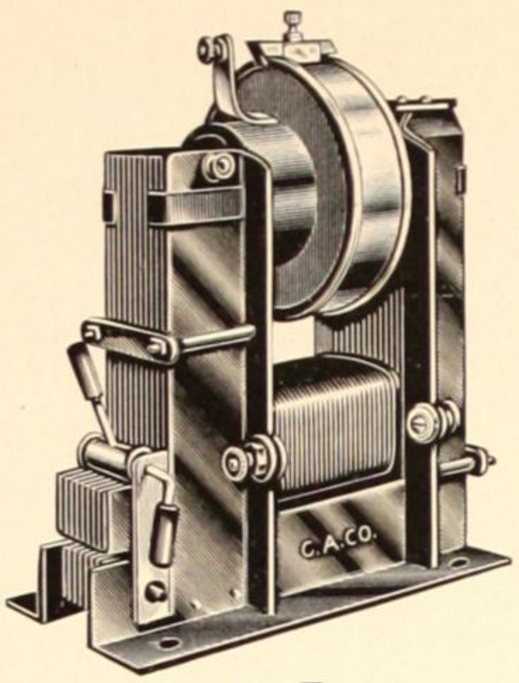
1034E. Transformer, Laboratory. Same as No. 1033Ea, but with binding post terminals providing permanent voltages of 6, 12, 18 and 24 volts, all of which can be used simultaneously. A voltage regulator provides 25 additional voltages ranging from 1 to 30 volts in approximately 1-volt steps. In black-enameled metal case, with cord and plug. Size 5¼x5x4 inches. Capacity, 150 watts. For use on 110-volt, 60-cycle A.C. circuits **$7.50**

1034Ea. Transformer, Laboratory. Same as No. 1034E, but for use on 110-volt, 25-cycle A.C. circuits **$9.00**

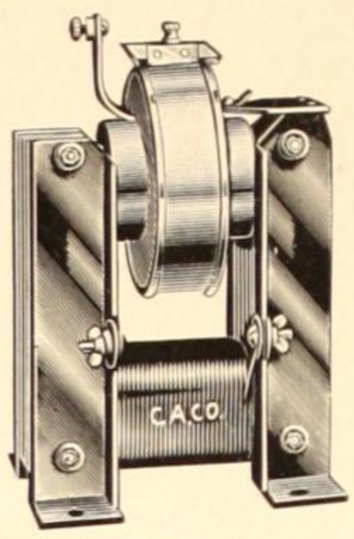
1038E. Transformer, Laboratory. Same as Nos. 1033Ea and 1034Ea, but smaller. Binding post terminals provide permanent voltages of 6 and 12 volts, which can be used simultaneously. A voltage regulator provides 18 additional voltages ranging from 5.5 to 22.5 volts in 1-volt steps. In black-enameled metal case, with cord and plug. Capacity, 75 Watts. For use directly on 110-volt, 60-cycle A.C. circuits **$4.00**

1038Ea.—Transformer, Laboratory. Same as No. 1038E, but for use on 110-volt, 25 cycle A.C. circuits **$5.50**

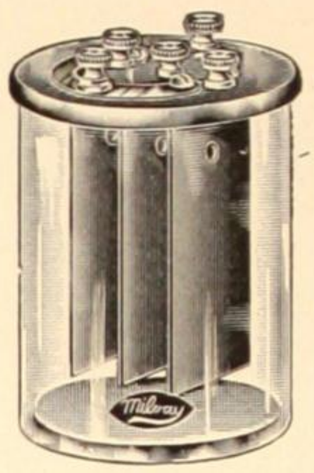
Transformers—Cont.



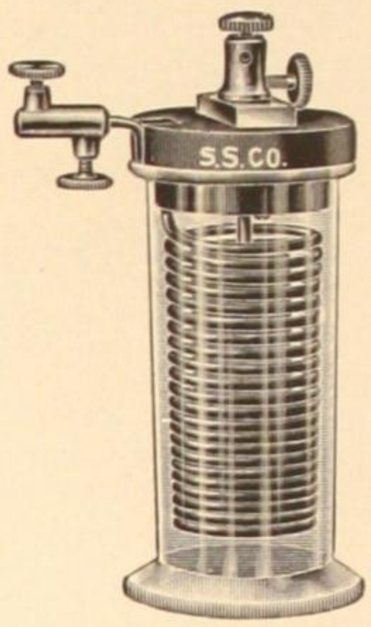
No. 1039E.



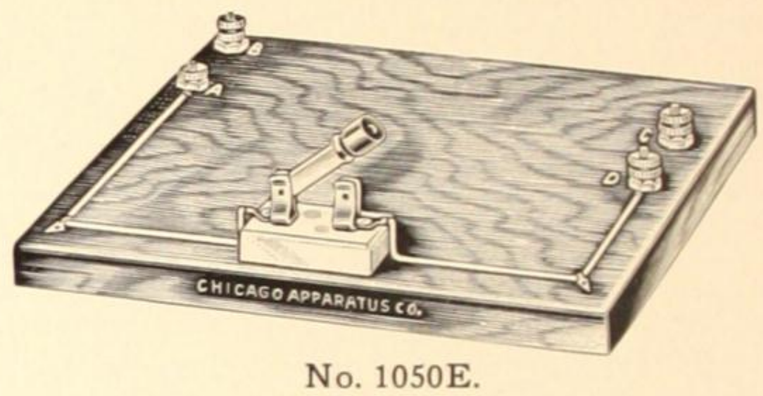
No. 1040E.



No. 1043E.



No. 1046E.



No. 1050E.

1039E. Transformers, Step-Up. For use in high frequency experiments, wireless, insulation testing, etc. Standard air-cooled spark transformers of the resonant type, with double resonant magnetic circuit, one variable by means of a movable tongue. This so-called magnet shunt provides full protection against undue current surges. The primary is designed to be connected directly to an alternating current source, no resistance or impedance coil being necessary. Finished in black enamel with nickeled terminal posts.

No.	A	B	C
For use on alternating current of, volts	110	110	110
Designed for current frequency of, cycles	60	25	60
Rating of secondary, volts	10,000	10,000	25,000
Capacity, kilo-volt-amperes (KVA)	½	½	1
Shipping weight, lbs.	38	48	62
Each	**$22.00**	**28.00**	**40.00**

1040E. Transformers, Step-Up. For use in high frequency and wireless experiments. Non-resonant type, differing from No. 1039E only in that these do not have the magnetic shunt control. The secondary is protected by an aluminum band or corona shield. For direct operation from alternating current source. Finished in black enamel with nickeled terminal posts.

No.	A	B
For use on alternating current of, volts	110	110
Designed for curr. frequency of, cycles	60	25
Rating of secondary, volts	8000	8000
Capacity, kilo-volt-amperes (KVA)	¼	¼
Shipping Weight, lbs.	15	20
Each	**$10.00**	**13.50**

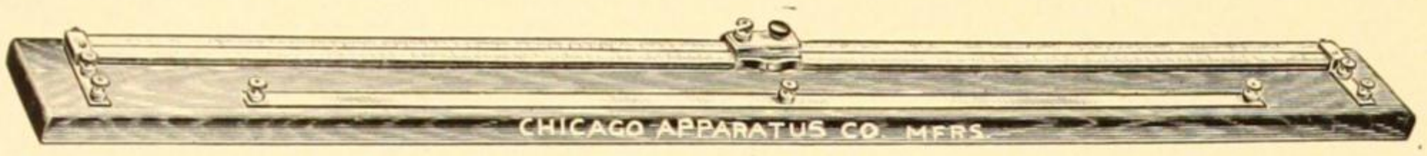
1043E. Voltameter, Copper (Coulombmeter), Milvay. For measuring current flow by electro-chemical effect. The three plates—one gain and two loss—are locked against the under side by three screws passing through the top. A turn of these screws releases the plates and eliminates touching them with the fingers. Area of each plate about 35 cm. Complete with glass jar **$3.50**

1044E. Voltameter, Silver (Coulombmeter), Milvay. Same size and construction as No. 1043E, with detachable silver plates **$7.00**

1046E. Voltameter, Copper (Coulombmeter), Pratt Rutger's Form. Designed by Prof. Frank R. Pratt, Rutger's College, where it has been in successful use for a number of years. The electrodes are detachable spirals of heavy copper wire. On a spiral the deposit distributes itself uniformly. On a square plate it accumulates so heavily on the edges that it often crumbles away and introduces serious errors in the results. Consequently far more accurate and more uniform results are obtainable with this spiral form. Complete with glass jar **$5.00**

1050E. Voltmeter-Ammeter Resistance Test Board, Dull's. For convenience in connecting unknown resistance coils, voltmeter, ammeter, and resistance box, battery or other current source, into the circuit employed in the study of the laws of resistance as outlined in Exp. 60, "Laboratory Exercises in Physics," by Chas. E. Dull (1929). Size, 30x25 cm. As illustrated **$2.50**

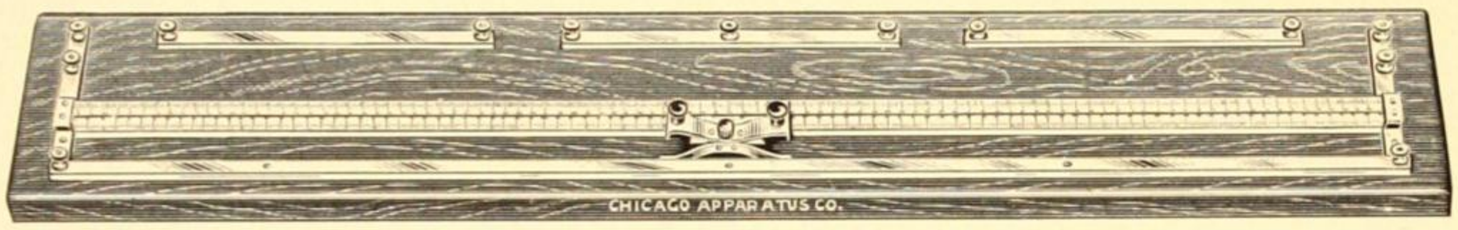
Wheatstone Bridges



No. 1053E.



No. 1055E.



No. 1057E.



No. 1063E.



No. 1065E.

1053E. Wheatstone Bridge. Standard Slide Wire Form. The resistance wire is one meter long, mounted on a scale graduated in millimeters, and provided with a sliding knife edge contact. The strips are of brass, $\frac{1}{16}$x$\frac{1}{2}$ inch. No soldered joints. The two bridge arms are each provided with a single gap for known and unknown resistances. Mounted on finely finished hardwood base, 10x110 cm., and provided with large binding posts. Complete with directions **$5.00**

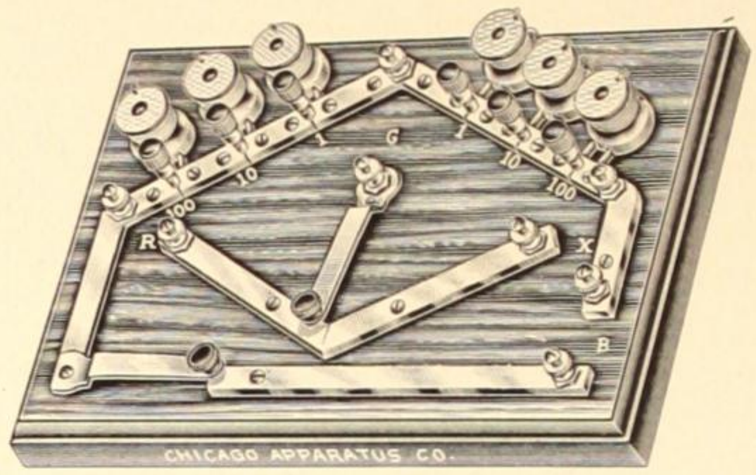
1055E. Sliding Contact Key. A standard key such as is used on our Wheatstone Slide Wire Bridges. Excellent for making sliding contact with a wire mounted on or stretched across a standard meter stick as in Exp. 67, "Laboratory Exercises in Physics," by Fuller, Brownlee and Baker.....**$0.75**

1057E. Wheatstone Bridge, Full Meter, Slide Wire Form, High Grade. No soldered joints. Strips of heavy copper, two gaps in each arm. Scale one meter long, graduated in millimeters. Resistance wire has a negligible temperature coefficient. Contact key has contact at each end so that approximate point of balance may be more rapidly located. No loose dangling wire lead to key necessary as in this bridge the key makes good electrical contact with the heavy metal strip along which it slides. This metal strip is provided with binding posts at each end, to either one of which the galvanometer wire is attached. On finely finished hardwood board 17.5x110 cm....**$18.00**

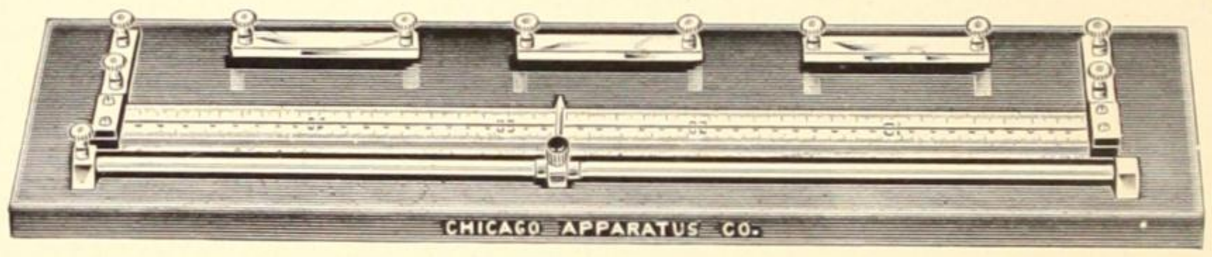
1063E. Wheatstone Bridge and Potentiometer. As used in Millikan, Gale and Bishop's Course. Consists of a finely finished hardwood base, 10x110 cm., provided with suitable binding posts and a brass conducting strip. When a resistance wire is stretched between the two back binding posts, which are placed exactly one meter apart, and a meter stick placed under the wire, it becomes a standard slide wire Wheatstone bridge like our No. 1053E. In addition, three binding posts—separated by distances of 20 and 80 cm.—are placed in front as illustrated. These enable this bridge to be used for finding the relative resistances of different kinds of wire by the fall-of-potential method; complete, but without meter stick **$4.50**

1065E. Potentiometer Board, Dull's. For studying the fall of potential along a conductor as outlined in Exp. 66 of Dull's "Laboratory Exercises in Physics." Consists of one meter each of Nos. 24 and 27 nichrome wire with binding post terminals, mounted on a mahogany-finished board. Markings on this board clearly indicate the 25, 50, 75 and 100 cm. points on the wires **$3.75**

Wheatstone Bridges—Cont.



No. 1073E.



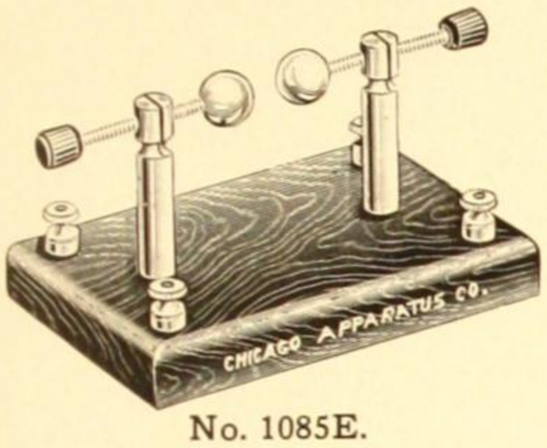
No. 1078E.

1073E. Wheatstone Bridge, Demonstration. New form. Easier for the student to understand, as all connections and resistance coils are in plain view on the upper surface of the board. Furthermore, the Wheatstone's diagram, given in every physics test book, is closely followed. As the coils are adjusted to an accuracy of 1/5 of 1%, very accurate determination can be made with this bridge. The resistances of the coils in each proportional arm are 1, 10 and 100 ohms. The total range of measurement—when our No. 833E Resistance Box, 211 ohm capacity, is connected across the "R" gap—is 0.001 to 21,100 ohms. With a resistance box of larger capacity the range is proportionately larger. The known resistance, unknown resistance battery and galvanometer gaps are plainly marked. The plugs are provided with non-removable knurled hard rubber tops. The metal strips are heavily lacquered and mounted on a finely finished 23x33 cm. hardwood base.....**$13.50**

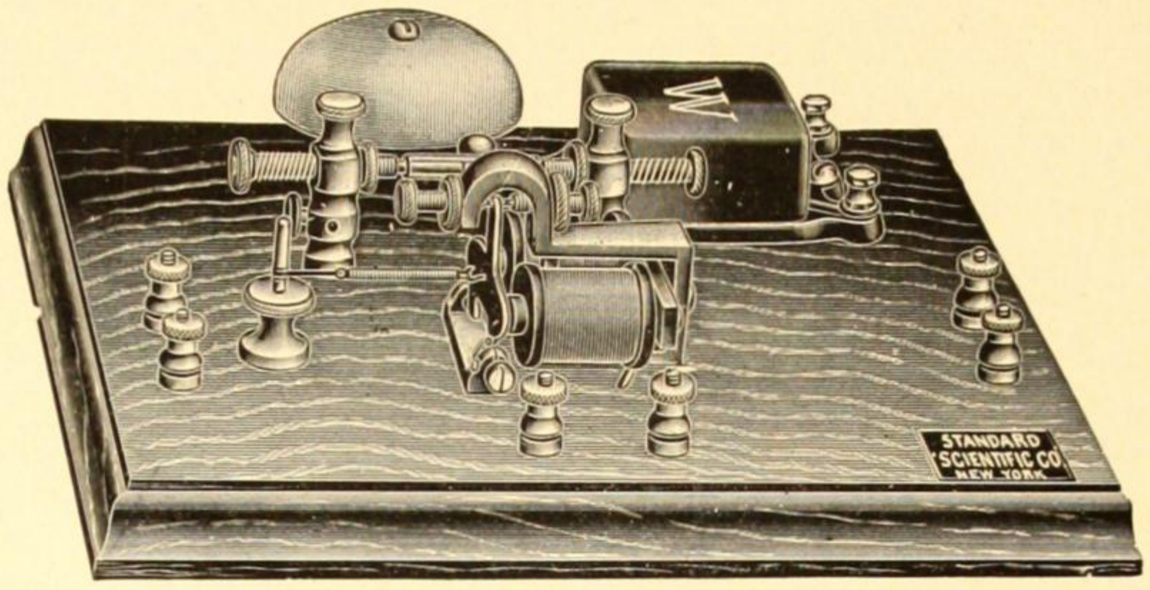
1076E. Wheatstone Bridge, Extended Coil Type. A ten-meter and half-meter bridge combined. The boxwood scale is graduated along its upper edge from 475 to 525 cm., and along its lower edge from 0 to 50 cm. in 1 mm. divisions. A 50 cm. length of wire, of low temperature coefficient and high resistance, is stretched over this scale and connected between two additional 475 cm. lengths of like wire wound on spools, making the total effective length 1000 cm. or 10 meters. When the two plugs are in place, the wire on the spools is 'shorted' out, and the instrument becomes a half-meter bridge of the usual type, on which the approximate value of a resistance can be quickly determined. By removing the two plugs, the instrument becomes a ten-meter bridge, on which the real value of the resistance can now be determined with extreme precision. Since settings can be readily made and repeated to within 1 mm., it is obvious that when the 10-meter bridge is used, such settings are accurate to .01%. Complete as illustrated, with sliding key.....**$40.00**

1078E. Wheatstone Bridge, Half Meter. Simple Carey-Foster type. For measurement of resistances, etc. May also be used—by short circuiting the two end gaps—as an ordinary Wheatstone bridge. The resistance wire, 50 cm. long, is mounted on a scale graduated in millimeters. The knife edge contact slides easily along a brass tube with which it makes good electrical contact. With this type of key the galvanometer wires do not interfere with the movement of the key, the knife edge always makes contact at right angles to the wire, adjustments can be made with great exactness. Mounted on finely finished hardwood base, 14x60 cm., and provided with large binding posts. Complete with directions **$22.50**

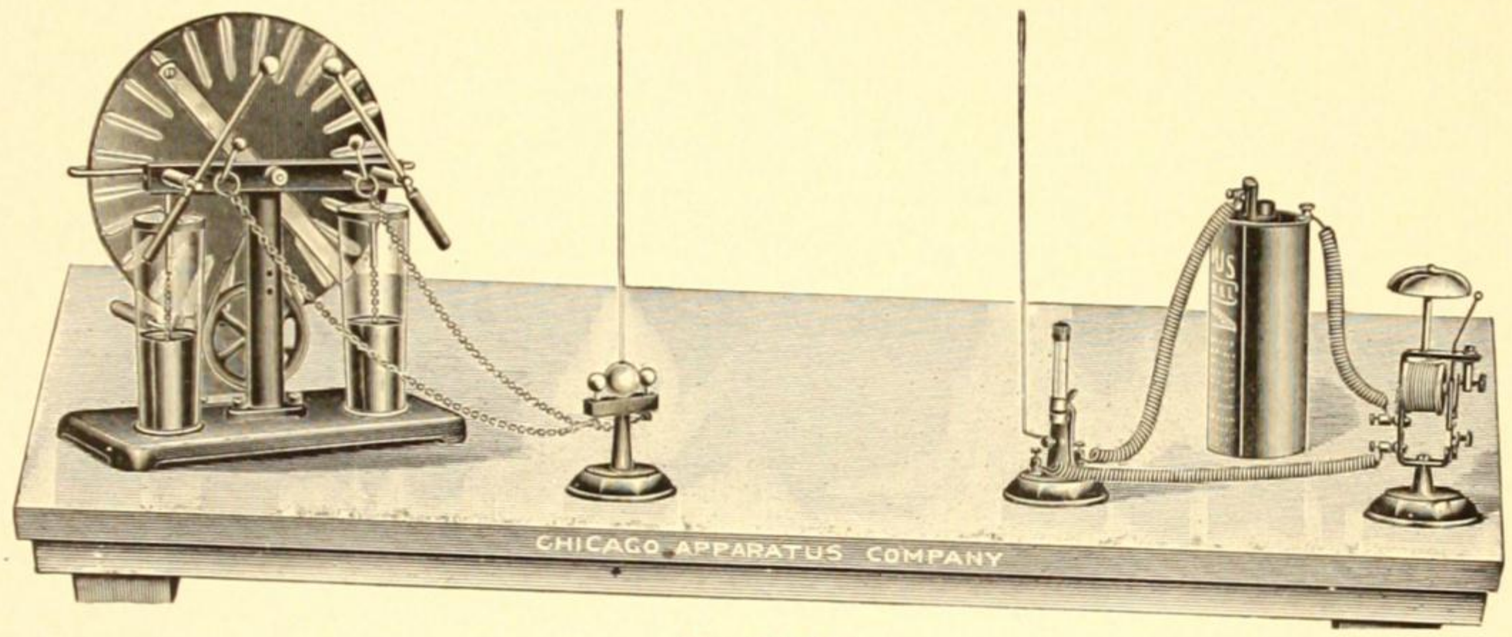
Wireless Telegraph Apparatus



No. 1085E.



No. 1086E.



No. 1093E.

The apparatus listed below is the simplest for demonstrating in the lecture room the transmission and reception of wireless waves. It is also important from a historical standpoint, as the type of coherer used in our receiving station is of the Lodge type, which, like the Branly, was one of the first successful detecting devices employed in the reception of wireless messages.

A complete wireless set can be readily hooked up by the use of our No. 1085E Wireless Oscillator and No. 1086E Wireless Receiving Set, with the addition of such standard laboratory items as: induction coil, ¼ inch spark, like our No. 643E; contact key, like our No. 658E; and four dry cells, like our No. 113E. If in addition, a sounder, like our No. 968E, is connected into the receiving circuit, the signals may be transmitted in code.

As complete directions and wiring diagrams are furnished with the instruments listed below, a complete set as described above can be readily and quickly assembled. Such a set when used with a ¼ inch spark induction coil will give good results across any lecture room or laboratory. When larger coils are employed and the aluminum plates replaced by aerial and ground wires, transmission over greater distances is possible.

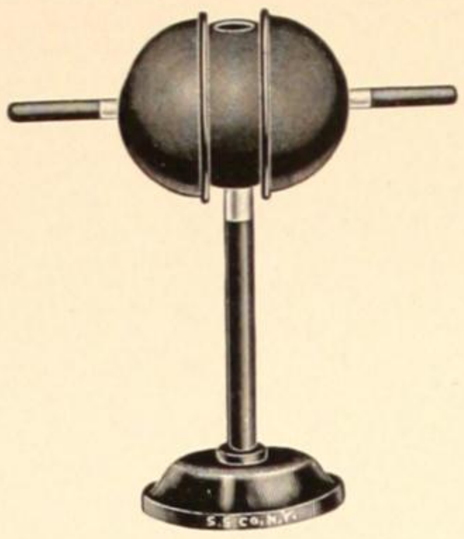
1085E. Wire Oscillator. For use with an induction coil as a transmitting station for wireless telegraphy. The spark gap is adjustable and provided with two pairs of binding posts, one pair for connecting into the secondary circuit of an induction coil, the other for attaching the aluminum receiving plates. Complete on 10x15 cm. harwood base, with two aluminum plates **$6.00**

1086E. Wireless Receiving Station. Consists of a standard Lodge coherer; a bell, which acts both as a sounder and decoherer; and a sensitive relay, mounted on a 22.5x22.5 cm. neatly finished hardwood base. The wiring scheme is clearly marked on the upper surface of the instrument (not shown in cut) so that all circuits can be traced with ease. Complete with two aluminum receiving plates, complete with directions, and wiring diagram..... **$16.00**

1093E. Wireless Set, Simple. For clearly illustrating the principles of wireless telegraphy. Its extreme simplicity and open construction enables the tracing of circuits and examination of every part. Very easy to operate and gives positive results. The vertical construction makes it an ideal set for the lecture table. One dry cell operates the receiving instruments; any Wimshurst machine, Toepler Holtz machine or induction coil, the sending instrument. Consists of a three-ball double spark gap with aerial wire, coherer with aerial wire, and a special electric bell; all mounted vertically on iron bases. Complete with full directions describing ten interesting experiments which can be performed with this outfit, but without dry cell and electric machine..... **$16.50**

Apparatus for Electrostatics

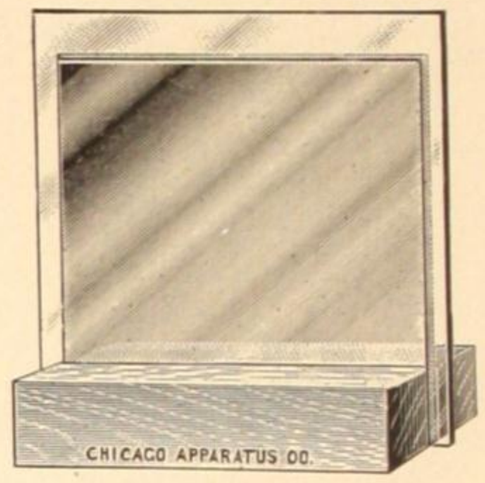
Section F



No. 6F-250F.



No. 12F.



No. 15F.



No. 37F.



No. 40F.



No. 45F.

6F. Biots Hemispheres. Consists of a pair of nickel-plated brass hemispherical shells with ebonite insulating handles to be used with No. 250F Hollow Globe. When the metal sphere is electrified, then the two metal shells placed around it, the shells on removal will be found to be charged while the sphere is no longer electrified.....**$2.50**

250F. Insulated Hollow Globe. To fit No. 6F Biots Hemispheres. Brass, nickel-plated, about 10 cm. diameter, on insulating stand, with hole in top for proof plane **$4.00**

10F. Chains, Brass. Provided with ring at one end and snap at the other for connecting accessories to static machines. Length, 45 cm.....**Per pair $0.25**

12F. Milvay Charging Rod. This improved friction rod provides a simple and certain means of charging electroscopes, insulated conductors, induction spheres and other electrostatical devices with either negative (—) or positive (+) charges. Holding the rod at the center and actuating the plunger with the forefinger causes friction between two small pieces of flannel and a celluloid rod producing a negative (—) charge on the aluminum tip. By bringing this tip into contact with the knob of an electroscope or other device the charge is transferred to it. By grasping the exposed portion of the celluloid rod and pressing the plunger down several times on a good static insulator (piece of glass or hard rubber), the plunger becomes positively (+) charged and this charge likewise may be transferred to an electroscope or other apparatus by the contact method described above.

The construction of the Milvay Charging Rod is such that the charges flow slowly from the tip and plunger—not instantaneously. Because of this, electroscope, electrometers, etc., can be charged to any precise desired point while an excessive charge can be reduced or entirely neutralized by a charge of the opposite sign. The friction mechanism is enclosed in a brass nickel-plated case. A high-grade instrument of finest material, workmanship and finish. Total length, 19.5 cm.....**$9.00**

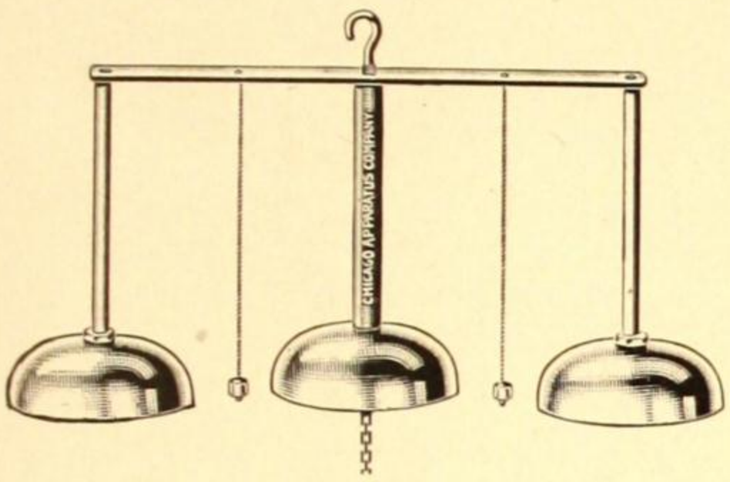
15F. Condenser Plates. As used in Millikan, Gale and Bishop's Course. Consists of a pair of 10x10 cm. metal plates, mounted on separate wooden bases; complete with 15x15 cm. shellacked glass plate.**$0.50**

35F. Direction Book. Contains full direction diagrams showing how to operate the various pieces included in our No. 135F Demonstration Set with either a Toepler-Holtz Machine or a Wimshurst Machine **$0.25**

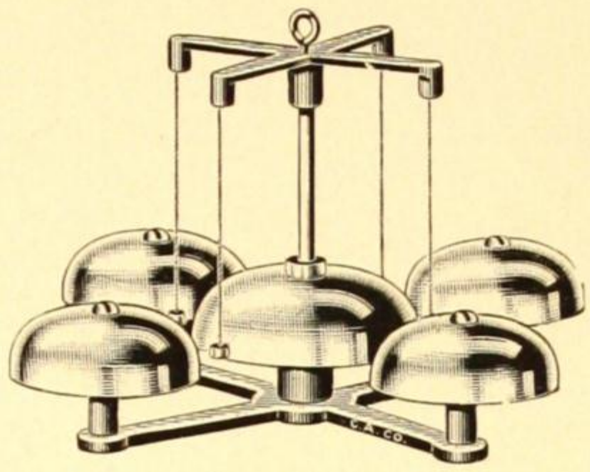
37F. Discharge Pressure Apparatus. The heat of an electric discharge violently expands the air through which it passes. In this device the air is confined in a hollow cylinder of insulating material, the circular opening in the top of which is plugged with a large pith ball. The cylinder is provided with two electrodes and when the discharge from a static machine or coil is passed between them the pressure developed by the spark-heated air ejects the ball with considerable force. Overall height, 18 cm. **$2.50**

40F. Discharger. Jointed. Adjustable arms. Knobs may be separated any distance up to 37.5 cm. Nickel-plated arms and knobs, rubber insulating handle.**$2.00**

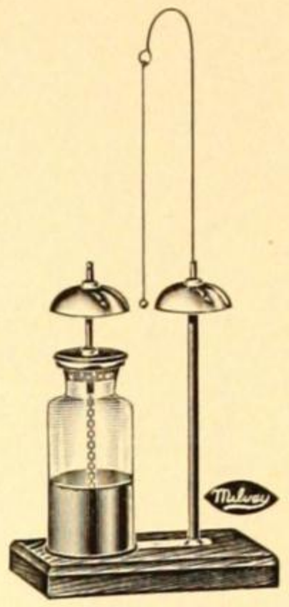
45F. Discharger. Plain. Fixed arms, rubber insulating handle. Arms and knobs are heavily nickel-plated. Distance between knobs 19 cm.....**$1.20**



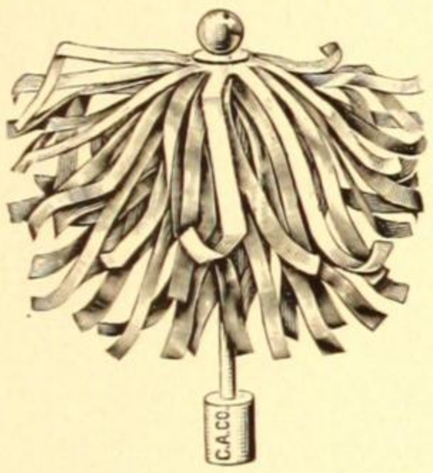
No. 55F.



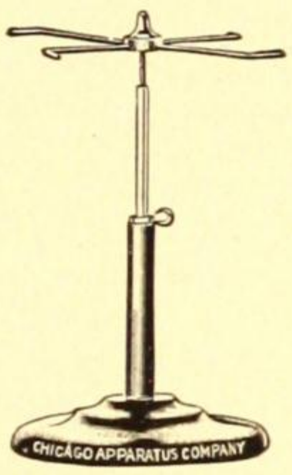
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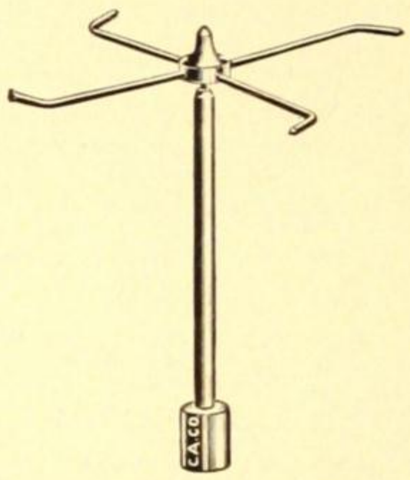
No. 65F.



No. 70F.



No. 75F.



No. 80F.

55F. Electric Chime. Three 50 mm. bells attached to a metal frame so that they may be suspended from the knob of a static machine. The center bell is insulated and provided with a ground chain. Excellent for illustrating the attraction and repulsion of electric charges **$2.00**

60F. Electric Chime. Five bells on metal mount with socket to fit on No. 515F Support..... **$3.25**

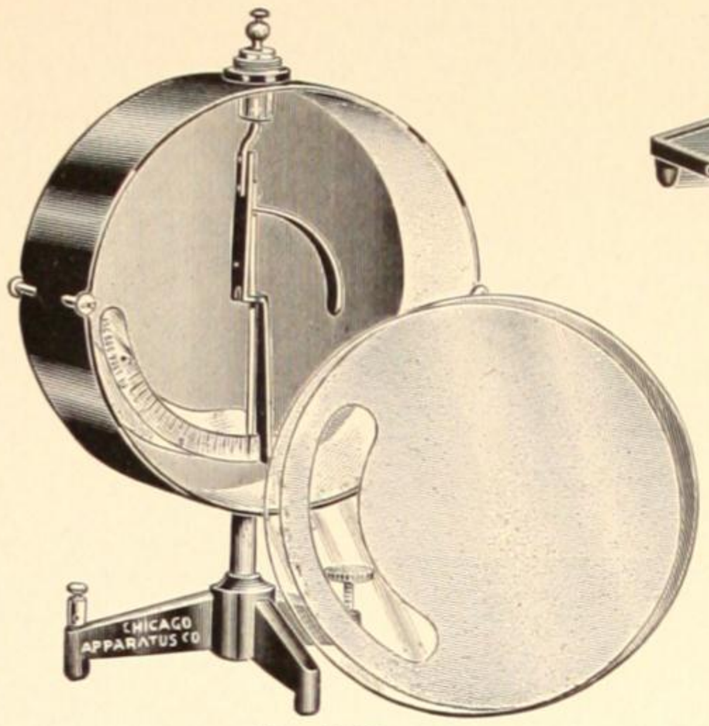
65F. Electric Chime, Milvay. Rings ten minutes on one charge. For illustrating, in an interesting manner, the attraction and repulsion of static charges. If the Leyden jar is charged, the metal ball suspended by a silk thread between the two bells will bound back and forth for ten or more minutes, thus ringing the bells.

Consists of a half-pint Leyden jar mounted on a 4x6 inch hardwood base with bells and suspended ball as illustrated **$6.00**

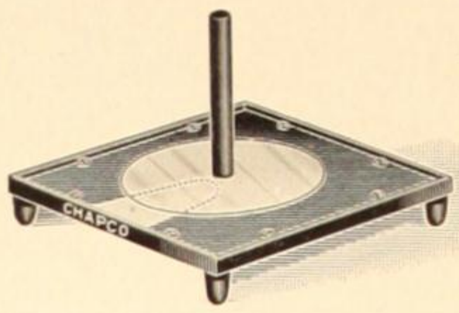
70F. Electric Plume. For illustrating repulsion. A paper tassel attached to a metal rod, the lower end of which is provided with a socket to fit on No. 515F Support. When connected to one knob of a static machine in operation, the strips of paper will repel each other and spread apart..... **$0.65**

75F. Electric Whirl or Flier. Brass cap with four radial arms terminating in sharp points, on insulating stand. When connected to one knob of a static machine in operation, it will rotate rapidly. Illustrates the great magnitude of the electric force at a point. Height about 12.5 cm..... **$1.35**

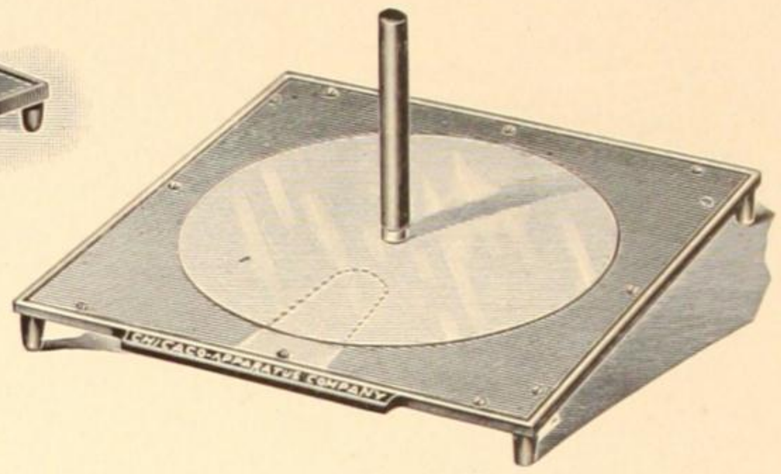
80F. Electric Whirl or Flier. Brass cap with four radial arms terminating in sharp points, on pivot designed to fit on No. 515F Support. When connected to one knob of a static machine, it will rotate rapidly. Illustrates great density of a charge at a point.. **$0.85**



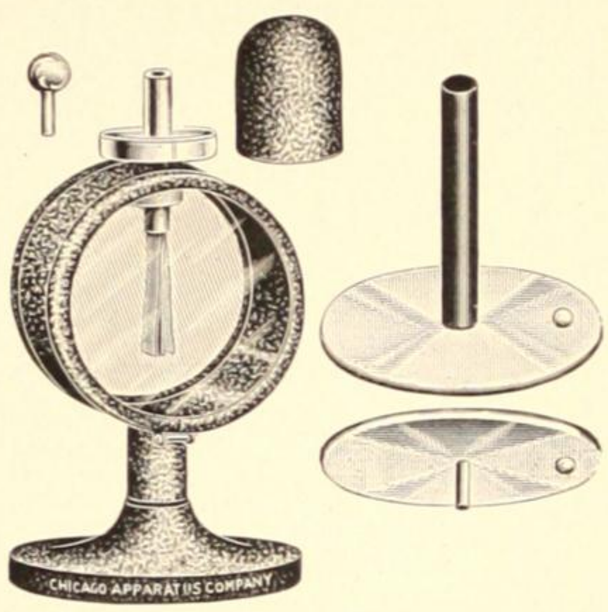
No. 87F.



No. 95F.



No. 90F.



Nos. 100F-105F.



No. 107F.

87F. Electrometers, Absolute (Electrostatic Voltmeters). After Braun. Consists of aluminum vane about 15 cm. long mounted on cone bearing in a metal frame of such shape that when a charge of electricity is given to this frame, the vane is repelled and stands at an angle to the frame. The size of this angle, as shown on the graduated scale, is used in voltage measurements. The frame, vane and scale are mounted in a cylindrical metal case from which they are insulated with pure amber. The case is provided with removable faces of clear glass, each covered with metal plate having a window through which the indications may be observed. In ordering, be sure to specify size wanted.

Size	1	2	3
Scale reads 0 to, volts	1500	3500	10000
Value of each divis., volts	100	100	500
Each	**$50.00**	**50.00**	**50.00**

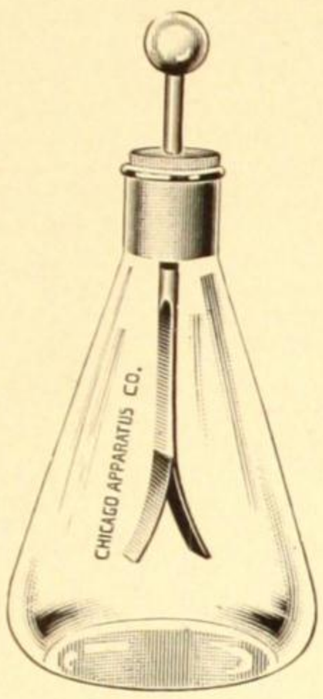
90F. Electrophorous, Large. Ebonite plate, 25x25 cm., mounted on japanned iron base; metal disk, 15 cm. diameter, with insulating handle. A metal strip, indicated in cut by dotted line, allows the negative charge, which is repelled by the electrified ebonite plate, to escape to the earth. The metal disk when raised will be found to have a positive charge, without having been touched with the finger. For charging a Leyden jar or insulated conductor, quickly and strongly, this electrophorous is unexcelled.....**$4.00**

95F. Electrophorous, Small. Same as No. 90F, but with 15x15 cm. ebonite plate and 10 cm. diameter metal disk with insulating handle.....**$1.50**

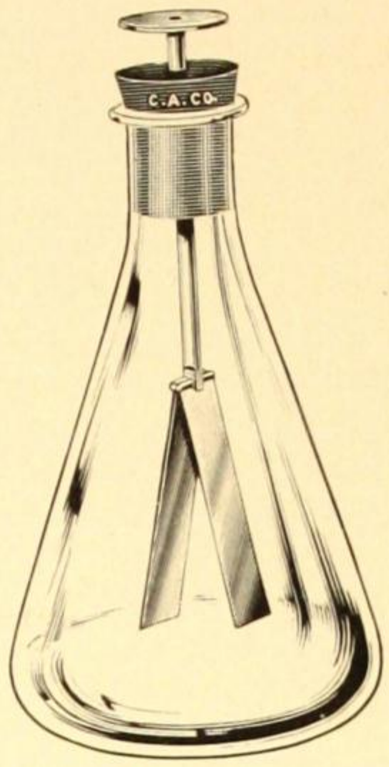
100F. Electroscope, Milvay, New Lecture Form. Consists of a round 11.5 cm. metal box with removable glass front and back mounted on a neat round metal base. The brass rod to which the gold foil is attached is insulated by a heavy, non-breakable sulphur plug. To guard against radio-active influences, a metal cap is provided to fit over the collar on top of the box and enclose the projecting rod. The rod is provided with a knob which may be removed and No. 105F Plates attached. This electroscope will hold its charge for from 6 to 8 days.....**$6.00**

105F. Condenser Attachment. For use with No. 100F, for showing that the plates of a galvanic cell are statically charged. Consists of two heavy shellacked brass plates 12.5 cm. in diameter, one of which is provided with an insulating handle, the other a rod for attaching to electroscope. With posts for attaching connecting wires **$3.75**

107F. Electroscope, Braun's. Consists of an aluminum vane about 15 cm. long pivoted on cone bearings in a metal frame of such shape that when a charge of electricity is given to this frame, the vane is repelled and stands at an angle to the frame. The size of this angle is used to measure the amount of electric charge. On insulating base.....**$5.25**



No. 110F.



No. 120F.

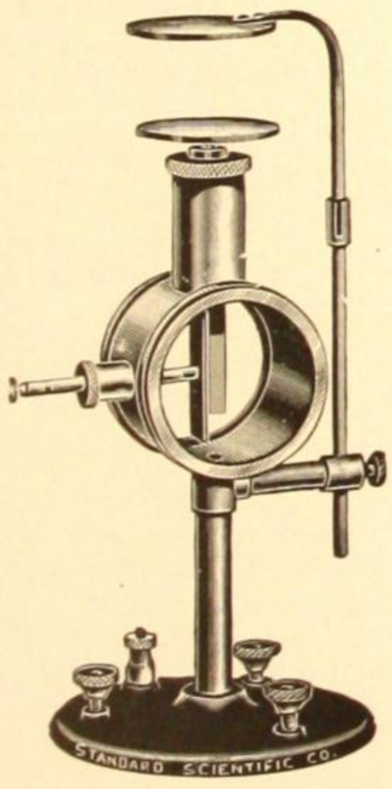
110F. Electroscope, Flask Form. 360 cc. flask, aluminum leaves, nickel-plated rod and ball. Height, about 16 cm. **$0.75**

115F. Electroscope, Flask Form. Same as No. 110F, but with rod insulated from the cork by a heavy non-breakable sulphur plug. Will hold its charge for hours. The best low-priced electroscope on the market **$1.75**

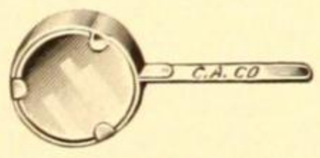
120F. Electroscope, Flask Form. Large model for lecture table use. 1000 cc. flask, large thin sheet (not foil) aluminum leaves, very sensitive and very durable. Height about 25 cm.....**$2.50**

Zeleny Oscillating Electroscope

122F. Electroscope, Zeleny Oscillating. Complete with all attachments. Designed by Prof. John Zeleny of Yale University. Designed for both qualitative and quantitative work in radioactivity and other ionization experiments. Unequaled for lecture experiments, such as: the conductivity produced in air by Roentgen rays—the conductivity produced by radio-active substances—the effect of ultra-violet light on the conductivity of air surrounding a glowing wire—the conductivity of flame gases—the electrification of air by the breaking up of water drops—the electrification of gases evolved when metals go into solution—the insulating properties of both solid and liquid materials—the range of Alpha, Beta, and Gamma rays from radio-active preparations, etc. It may also be used in comparison of very high resistances. (See The Physical Review, Vol. 32, 1911, page 581.) The electroscope leaf is broad and moves in its own plane; the air resistance thus encountered is so small that it cuts through the air with a precise, rapid pendular motion. The leaf is automatically charged and recharged from a plate kept at about 100 volts. When an ionization current is being measured the leaf alternately approaches and "kicks" away from the plate, the frequency of these pendular motions being a measure of the current. Since the leaf is viewed broadside on, its oscillations can be readily seen simultaneously by a group of observers. It is equally well adapted for projection—a feature which gives it added value for lecture purposes. The automatic charging of the leaf results in the experiment constantly repeating itself before the eyes of the observer or audience, thus adding life and fascination to the experiment. The effect of any change in conditions is immediately noted by a change in the frequency of the oscillations. In making quantitative measurements, the time of a counted number of oscillations is taken, the "kick" of the leaf from the charging plate making a very definite point for taking time. The sensitivity of the electroscope can be varied over wide limits by simply moving the charging plate in or out. Complete with attachments, in wooden case; and illustrated bulletin, prepared with the co-operation of Prof. Zeleny, containing complete directions and describing in detail a number of interesting experiments which can be readily performed with this instrument.....**$18.00**



No. 122F.

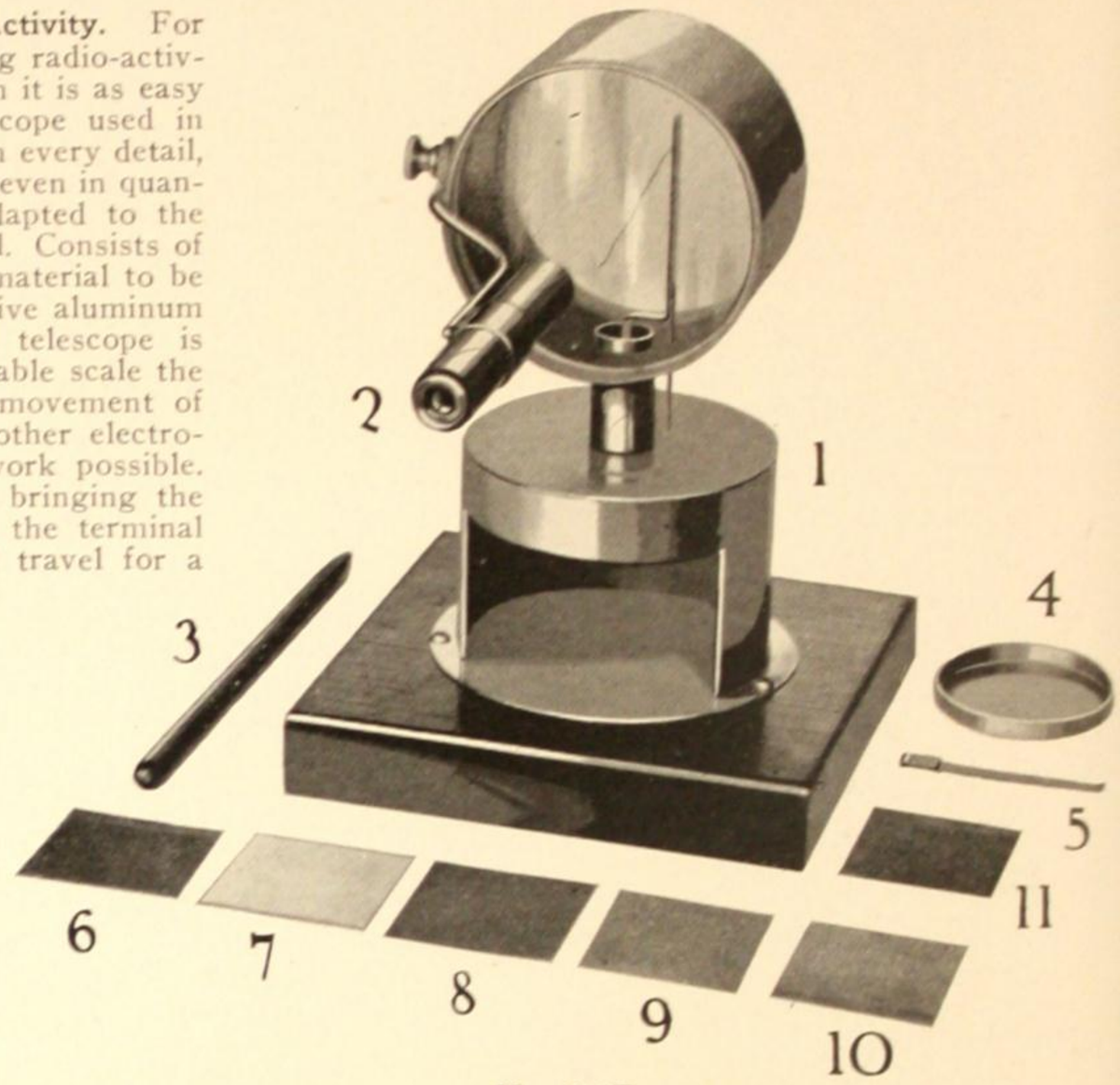


No. 121F.

121F. Beta Ray Capsule. For use with No. 122F. A small metal capsule with handle containing an intensely radio-active material, assaying 16.92 milligrams of radium per ton. Useful as a source of Beta Rays for laboratory and lecture work.....**$5.00**

Hammer Radio-Activity Electroscope

123F. Electroscope, Hammer Radio-Activity. For studying, demonstrating and measuring radio-activity. Because of the simplicity of design it is as easy to use as the ordinary flask electroscope used in electrostatical work. Being complete in every detail, no accessory instruments are required, even in quantitative work. It is therefore well adapted to the needs of all laboratories, large or small. Consists of two compartments, the lower for the material to be tested, the upper containing the sensitive aluminum electroscope leaf. A simple reading telescope is mounted in front for reading on a suitable scale the angular displacement as well as the movement of the leaf. This feature, not found in other electroscopes, makes accurate quantitative work possible. In use the instrument is charged by bringing the rubbed friction rod into contact with the terminal on the outside of the case. The leaf travel for a standard radio-active substance (No. 124FB Carnotite) is then determined. This standard is then replaced by the test sample. The leaf travel is again noted. Comparing the results gives the exact amount of radio-active material in the sample under test. The case is of solid polished brass, mounted on a neat base. Complete, including reading telescope, charging rod, dish for solids, leaf protector clip, set of No. 124FA Plaques of Radio-Active Materials and six-page illustrated bulletin giving full directions for use and a brief history of radium, its occurrence, extraction, crystallization and uses **$25.00**



No. 123F.

Radio-Active Materials and Screens

124Fa. Plaques of Radio-Active Materials, Set of Six. For use with No. 123F Hammer Electroscope, No. 122F Zeleny Electroscope or other type of electroscope designed for testing radio-activity. Consists of one plaque each, 1x1½ inches, coated with High-grade Pitchblende, High-grade Carnotite, Crude Radium Sulphate, Thorium Oxide, Crude Actinum, and Uranium. Per set of six..... **$2.50**

124Fb. Carnotite Standard. An analyzed sample of carnotite ore containing about 2 per cent of U308. Produces, in No. 123F Electroscope, a leaf travel of about two divisions per minute..... **$1.00**

124Fc. Carnotite Specimen. About 50 grams.... **1.50**

124Fd. Pitchblende Specimen. About 50 grams. **1.50**

124Fe. Phosphorescent Zinc Sulphide, Special Grade as used in radium paints. Per 5 gram bottle, **$3.50** Per 25 gram bottle..... **$10.00**

124Ff. Phosphorescent Zinc Sulphide, Grade A. Extra strong phosphorescence. Used in the painting of outdoor signs. Per 5 gram bottle, **$2.00.** Per 25 gram bottle **$4.00**

124Fg. Phosphorescent Zinc Sulphide, Grade B. Strong phosphorescence. Per 5 gram bottle, **$1.00.** Per 25 gram bottle..... **$2.00**

124Fh. Radium Luminous Material. Radium paint. Bottle contains sufficient powder to render self-luminous the dials of about 20 watches. Per ½ gram bottle **$5.00**

124Fk. Triboluminescent Zinc Sulphide. Bright yellow phosphorescence after exposure to light, or after rubbing. Per 5 gram bottle, **$2.00.** Per 25 gram bottle **$4.00**

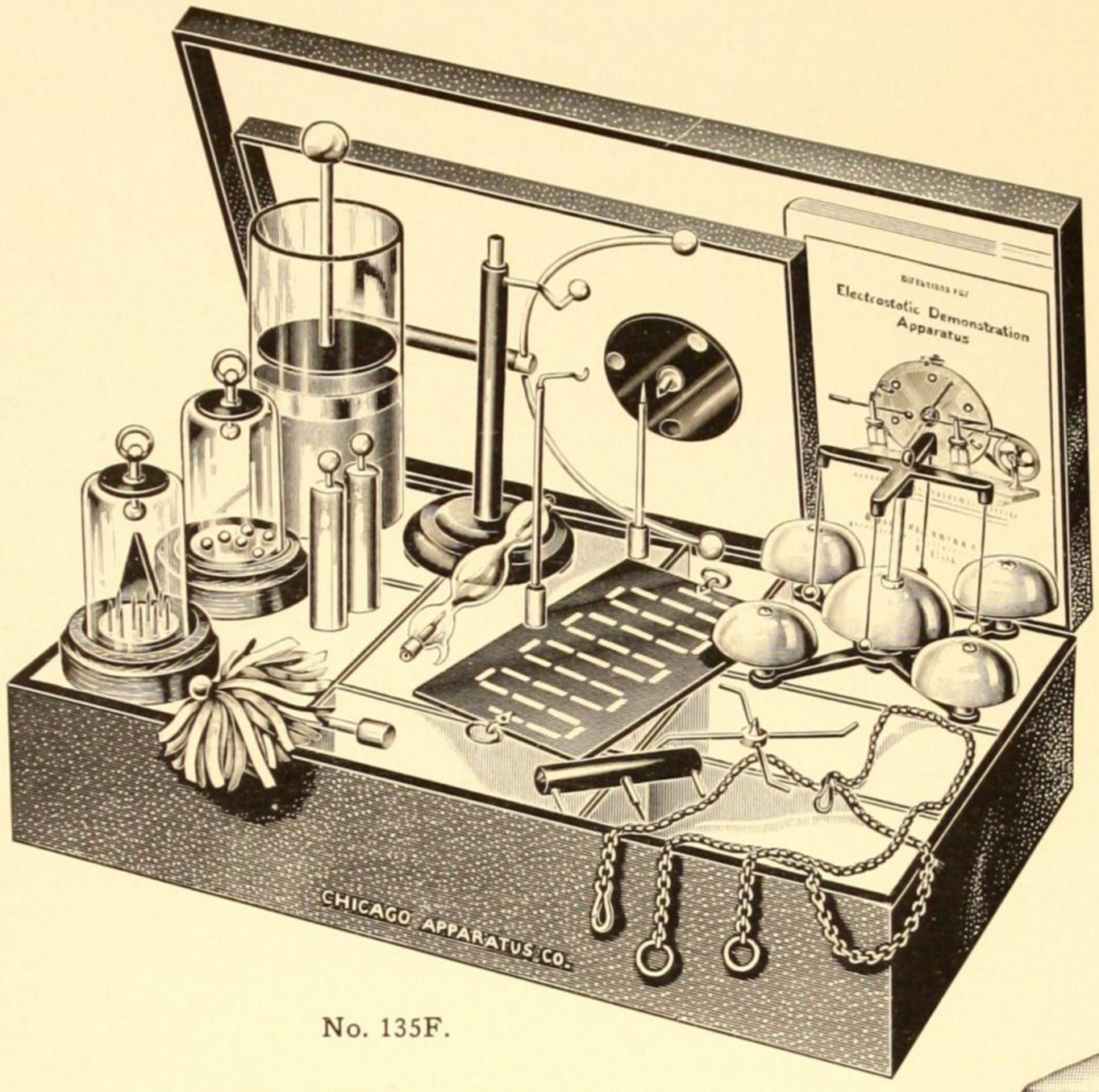
124Fl. Phosphorescent Calcium Sulphide. Violet phosphorescence after exposure to light. Per 25 gram bottle **$2.00**

124FM. Phosphorescent Zinc Sulphide Screen. Bright green phosphorescence. Used in Radium, X-Ray and ultra-violet light experiments. Size, 4x4 inches. **$2.00**

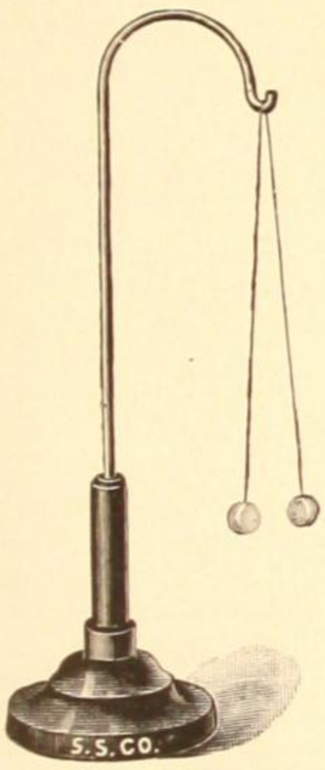
124Fn. Triboluminescent Zinc Sulphide Screen. Emits golden colored light. Size, 4x4 inches..... **$2.00**

124Fp. Phosphorescent Calcium Sulphide Screen. Beautiful violet phosphorescence after exposure to daylight or violet light. Size, 4x4 inches..... **$1.00**

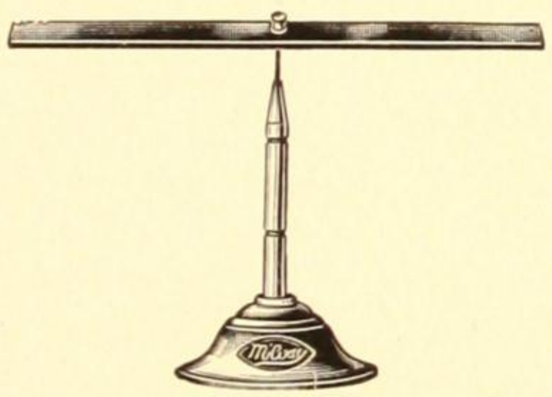
124Ft. Fluorescent Screen. Gives the nearest approach to white light. Used extensively in X-Ray and ultra-violet light experiments. Does not retain its luminosity after exciting cause is removed. Size, 4x4 inches **$3.00**



No. 135F.



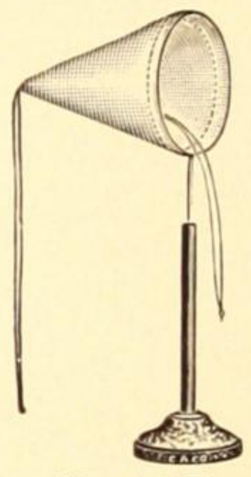
No. 125F.



No. 130F.



No. 96H.



No. 140F.

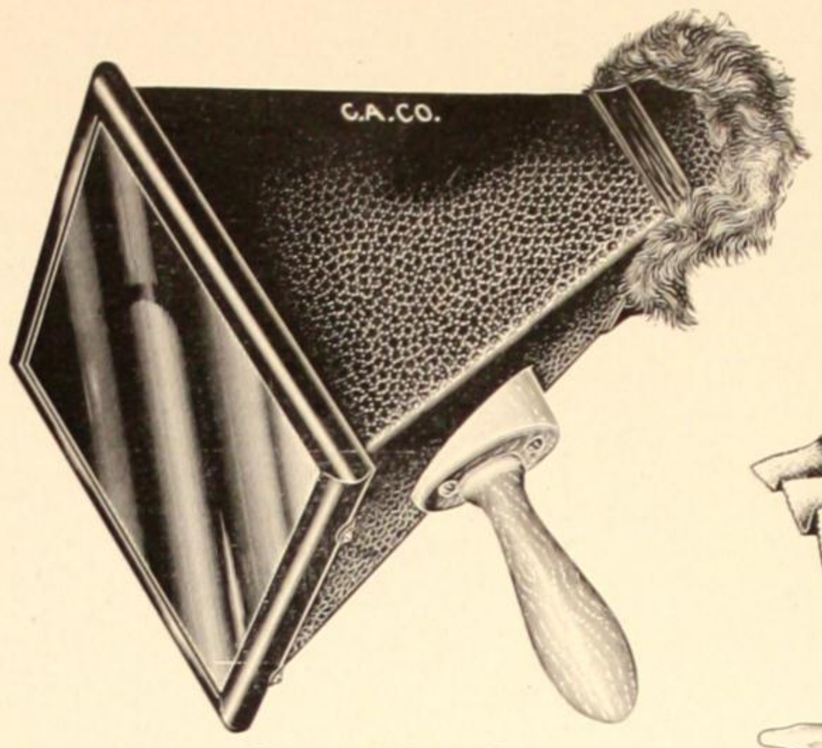
125F. Electroscope, Pith Ball. WITH EXTRA LARGE PITH BALLS, 13 TO 14 MM. DIAM. Consists of a pair of 13 to 14 mm. pith balls suspended by silk cords from an insulating stand. Height about 28 cm..... **$1.00**

130F. Electroscope, Vulcanite Needle Form. Milvay. Very sensitive. Hard rubber needle, about 15 cm. long, delicately pivoted on a support. One end may be charged positively and the other negatively, if desired, thus obviating the use of two electroscopes **$1.35**

135F. Electrostatic Demonstration Set. Consists of No. 515F Universal Support and the following accessory apparatus: No. 80F Electric Flier, No. 310F Rotating Disk, No. 70F Electric Plumes, No. 520F Volta's Hail Storm, No. 325F Smoke Condenser, No. 320F Smoke Candles, No. 210F Geissler Tube Holder, No. 270F Lightning Plate, No. 60F Electric Chime, No. 315F Shocking Handles, No. 10F Chains, No. 255 Leyden Jar, No. 45F Discharger, No. 200F Geissler Tube and No. 35F Direction Book. Put up in a strong cardboard compartment box. Every piece in this set will give highly satisfactory results with our Toepler-Holtz Machine or any of our Wimshurst Machines. An excellent outfit for lecture table work in static electricity..... **$22.50**

96H. Faraday's Ice Pail. For performing the classical experiments on the distribution and induction of static charges which Faraday originally carried out with the aid of an ice pail. A polished aluminum can, 3 inches in diameter and 5 inches high..... **$0.50**

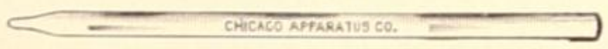
140F. Faraday's Bag. Consists of a cloth bag, 7.5x13 cm., attached to a metal ring which is mounted on an insulating stand. Silk cords attached to tip of bag enable it to be easily turned inside out. When bag is charged, it may be shown by proof plane and electroscope that the charge is entirely on the outside. If bag is turned inside out, the charge will again be found to be on the outer surface..... **$1.25**



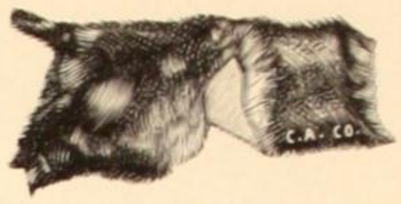
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No. 170F.



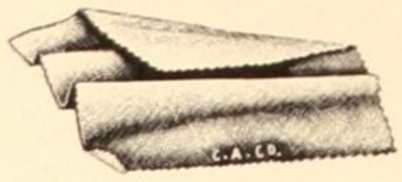
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No. 160F.



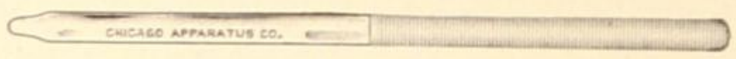
No. 165F.



No. 190F.



No. 195F.



No. 180F.



No. 185F.



No. 197F.

145F. Fluoroscope. For observing the bones in the hand, coins in a purse, etc., under the penetrating effects of X-rays. With removable calcium tungstate screen, 12.5x17.5 cm. (5x7 inches).....**$13.50**

146F. Fluoroscope, Professional Type. The brilliant results obtained in X-ray examinations with this fluoroscope are due to the remarkable characteristics of its screen: 1. The fluorescent salt from which the screen is made is an absolutely stable chemical combination and is not affected by heat or dampness, by the continual bombardment by X-rays, or by pressure. It does not deteriorate with age, like the barium platinum-cyanide screens so quickly do. 2. The light emitted by this screen is brilliantly white. The images therefore present black and white contrasts which are pleasing to the eye. 3. The screen is free from visible grain. This is a most important attribute as it assures images with sharp clean-cut outlines. 4. It has absolutely no phosphorescent afterglow or lag. This quality prevents blurred outlines when examining moving objects.

Expert Roentgenologists use this type regularly for the fluoroscopic examination of fractured bones, etc. Used with our No. 656E Induction Coil and No. 545F X-Ray Tube, because of the penetrating x-rays produced by this equipment, this fluoroscope reveals the bony structure of the Hand, Wrist, Elbow, Foot, Ankle, Knee, etc., with a contrast, sharpness, and clearness impossible with calcium tungstate or barium-platinum-cyanide-screen-equipped fluoroscopes. The screen, 5x7 inches, is covered by a glass plate on the inside to protect it from dust and is readily removable for examination or replacement. It is mounted in a finely finished box with handle and fur-lined eyepiece **$26.50**

150F. Friction Cap, Flannel. With silk thread attached, for use with No. 170F Ebonite Rod, to illustrate that friction develops opposite charges in equal amounts **$0.25**

155F. Friction Pad, Cat's Fur. Half skin for exciting friction rods, electrophorous, etc. **$1.00**

160F. Friction Pad, Flannel. For exciting friction rods, etc. Size about 20x25 cm.....**$0.35**

165F. Friction Pad, Silk. For exciting friction rods, etc. Size about 20x25 cm.....**$0.50**

170F. Friction Rod, Ebonite. When rubbed with cat's fur becomes negatively electrified. Made of best quality hard rubber. Length, 25 cm.; diameter, 13 mm. **$0.35**

175F. Friction Rod, Glass. Solid rod, better than a hollowglass tube. When rubbed with silk becomes positively electrified. Length, 25 cm.; diameter, 10 mm. **$0.30**

180F. Friction Rod, Glass. Solid rod, one end ground, the other polished. One end becomes positively electrified and the other negatively when rubbed. Length 30 cm.; diameter, 13 mm.....**$0.60**

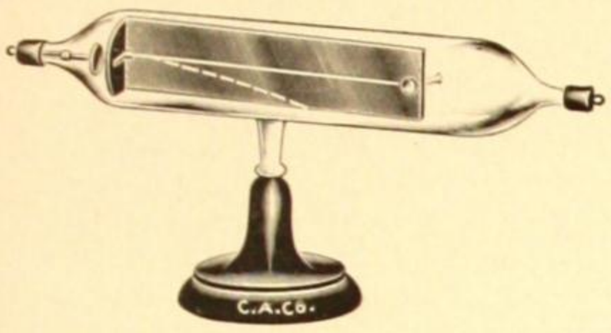
185F. Friction Rod, Wax. When rubbed with flannel becomes negatively electrified. Size, 25 cm. x 15 x 15 mm. **$0.20**

190F. Friction Rod Support. Better and more convenient than the suspended stirrup. The carrier, made of light-weight metal, is balanced on a hardened steel pivot mounted in the end of a hard rubber insulating rod. A bar magnet or friction rod resting on this carrier reacts readily to other magnetic or static charges. Without bar magnet.....**$2.50**

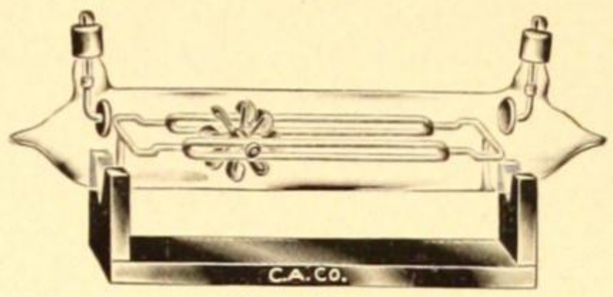
195F. Friction Strips. Glass. One plain, the other with half of one face covered with silk. For illustrating that friction develops opposite charges in equal amounts. Size, 7.5x2.5 cm.....**$0.40**

197F. Gassiott's Cascade. For producing an electrical cascade in a partial vacuum. In use this goblet, lined inside with the foil, is placed on the plate of an air pump and directly under the metal rod of a bell jar like our No. 70R, plate and rod being connected to the spark terminals of a static machine or induction coil. At reduced pressures the pink and violet colored discharges flow out of the goblet in water-fall or cascade fashion, producing a most beautiful effect **$1.50**

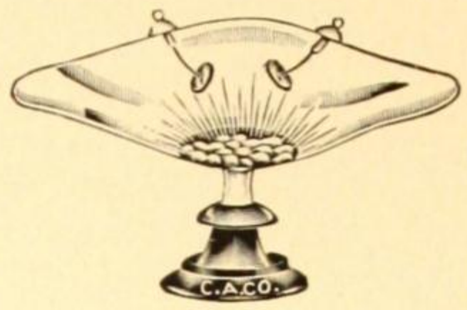
Geissler and Vacuum Tubes



No. 20F.



No. 22F.



No. 23F.



No. 25F.



No. 30F.

20F. Crooke's Deflection Effect Tube. For showing that cathode rays are deflected by a magnet. In this tube the cathode stream, narrowed down by a slit in a mica plate mounted directly in front of the cathode electrode, is caused to traverse the length of a mineral coated plate upon which it traces a fluorescent streak. The luminous band, which normally is quite straight, instantly bends into a circular arc, when the tube is approached by the end of a bar magnet. The curvature is either up or down according to which end of the pole is near the tube. Tube length, about 30 cm. With wooden stand.....**$7.50**

22F. Crooke's Mechanical Effect or Rolling Wheel Tube. For showing that cathode rays can produce mechanical effects. The aluminum disk electrodes are placed near the top of the tube. Between them is a small mica-vane wheel mounted on glass rails. When the tube is excited by a coil of 2 inch spark, or larger, the wheel rotates rapidly, the upper vanes moving away from the cathode and the whole wheel rolling along the glass rails towards the anode. Obviously if the current is reversed, the wheel will spin and travel in the opposite direction. If the cathode stream is deflected by means of a magnet, the speed of the wheel will be altered. Length of tube, about 31 cm.; diameter, 5 cm. Complete with wooden stand **$12.00**

23F. Crookes' Tube, Phosphorescent. A vacuum tube containing several minerals which glow with brilliant colors while a discharge from a static machine or coil is passing through the tube. Being phosphorescent, the glow persists for a time after the discharge has ceased. Diameter of bulb, 9 cm.; length 14 cm. On polished wooden base.....**$5.00**

25F. Crookes Tube, Shadow Effect. For showing that cathode rays travel in straight lines as is evidenced by the manner in which they cast a shadow, that they are deflected by a magnetic field, and that fluorescent glass fatigues under their stimulus. The metal cross is hinged so that it may be caused, by tipping the tube, to lie down or stand erect at will. When the cross is down, the whole large end of the tube will glow with a greenish-yellow fluorescence. When erect, a sharp shadow will appear in this fluorescent area. Approaching the tube with a magnet causes the fluorescent area to shift, obliterating the shadow partially or entirely, showing that the rays are being deflected. If the shadow of the cross is thrown on the walls of the tube for some time and the cross then shaken down, the pattern of the cross now will glow brighter than the surrounding portion, revealing that the portion originally screened from the cathode rays now responds more vigorously than the portion that underwent prolonged exposure to them. Length, about 28 cm.; diameter of large end, 8 cm. On wooden stand.....**$6.00**

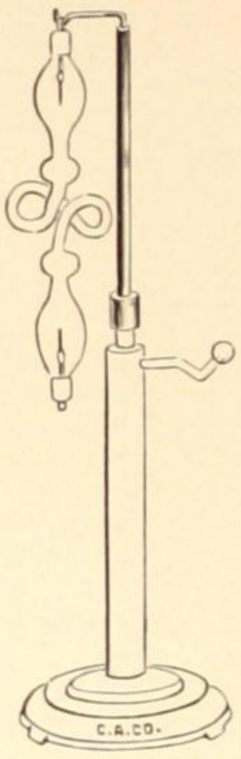
30F. Crookes' Heating Effect Tube. For showing that cathode rays heat bodies upon which they fall.

In this tube the cathode electrode is a section of a hollow square. In the center is mounted a square of platinum foil. In action the rays come off at right angles to the cathode forming a cone with its apex in the plane of the platinum. Thus the energy of the rays, concentrated into a small space, is so great that the foil at the tip of the cone becomes white hot. By deflecting the cathode stream with a magnet the position of the heated spot can be shifted. Diameter of bulb, 12 cm. On wooden stand.....**$7.50**

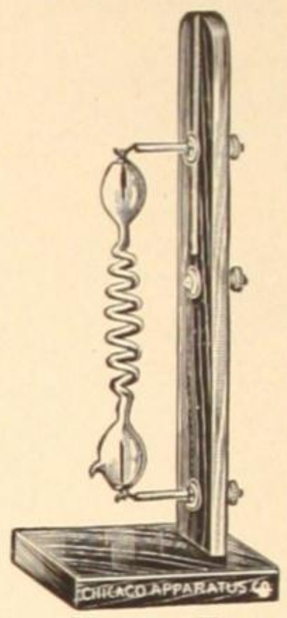
Geissler and Vacuum Tubes—Cont.



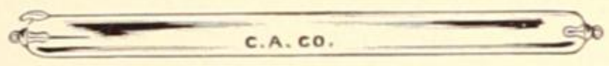
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No. 210F.



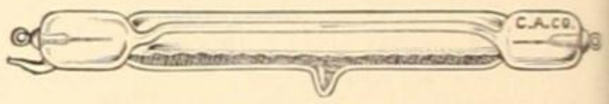
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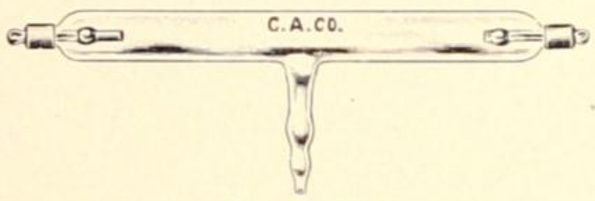
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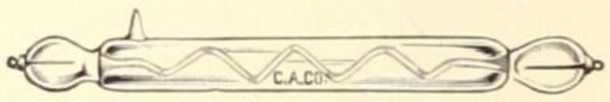
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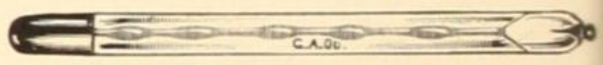
No. 214F.



No. 3600F.



No. 213F.



No. 216F.

Geissler Tubes

Sealed glass tubes of various designs, and of various kinds of glass, containing some highly rarefied gas and provided at each end with an improved electrode for easy connection to a static machine or coil. Any static machine or induction coil will operate these tubes. When an electric discharge is passed through them the gas becomes luminous, while the different kinds of glass exhibit fluorescence as follows: Uranium-Yellow; Iron-Green; Lead-Blue.

200F. Geissler Tube. 15 cm. long.....$0.75

201F. Geissler Tubes. 15 cm. long, set of six, assorted, in box $4.25

205F. Geissler Tube. 20 cm. long $0.90

206F. Geissler Tubes. 20 cm. long, set of six, assorted in box.....$5.00

210F. Geissler Tube Holder. A metal rod with socket at its lower end to fit No. 515F Support and hook at top for suspending Geissler Tubes or No. 270F Lightning Plate. Nickel-plated.....$0.65

215F. Geissler Tube Support. Consists of a 12.5x12.5 cm. wood base with a 30 cm. wood upright, provided with binding posts and adjustable hooks for supporting any tube from 15 to 25 cm. long. This stand is entirely finished in dead black against which the illuminated Geissler tube stands out in bold relief. Ideal for the lecture table use. Without Geissler Tube $3.00

211F. Aurora Tube. A simple vacuum tube, 25 cm. long, with an electrode in each end. A discharge through this tube produces a beautiful colored auroral glow $2.00

3600F. Aurora Tube. Same as No. 211F, but provided with open side tube for exhausting. Length, 25 cm. $1.75

212F. Holtz Tube. Consists of a vaccum tube, 15 cm. long, with a series of partitions provided with small tapered openings to show that the discharge will pass in but one direction through such openings.$2.50

213F. Fluorescent Tube. This is a double tube, 20 cm. long, the inner one of uranium glass, the outer being filled with some fluorescent liquid such as eosine, quinine, kerosene, aesculine, or uranine. When a spark is passed through this tube the liquid gives off light of a color differing from its own (fluorescence) $1.50

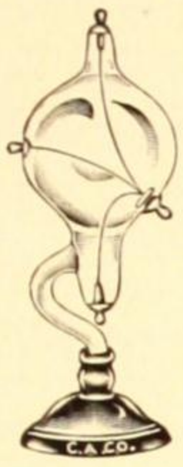
214F. Phosphorescent Tube. This is a double tube, 20 cm. long, the outer of which contains crystals of calcium sulphide and zinc sulphide. When a discharge passes through the tube the crystals phosphoresce beautiful green and violet colors, showing how radiant matter may produce visible light..$2.00

216F. Phosphorescent Mercury Tube. A double vacuum tube, 20 cm. long. The inner tube consists of a series of bulbs while the outer contains a quantity of mercury. When shaken, friction resulting from mercury falling on the glass bulbs, produces a beautiful phosphorescent glow. As no static machine or coil is required, this tube is not provided with terminals $2.50

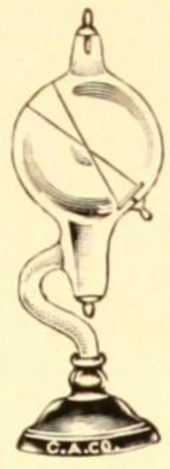
Geissler and Vacuum Tubes—Cont.



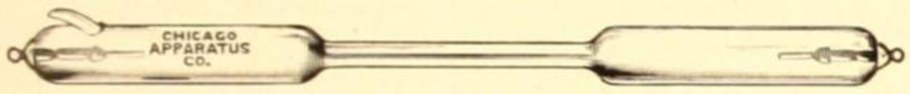
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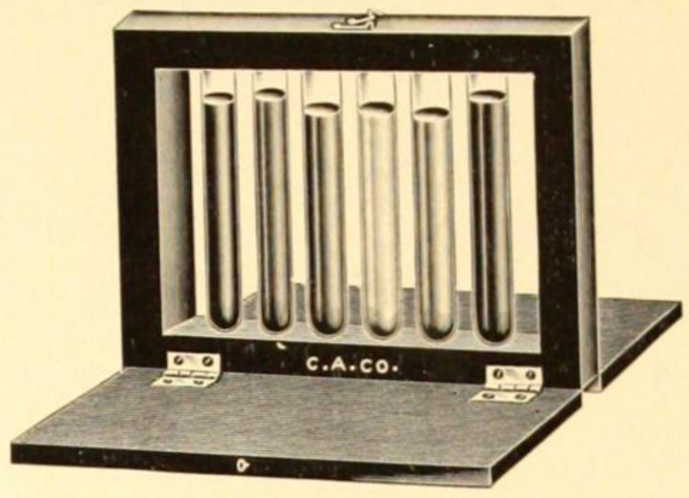
No. 218F.



No. 219F.



Nos. 326F-346F.



No. 3603F.



No. 3605F.

217F. Geissler Tube, Demonstration Form. Total height, 28 cm. Fancy uranium glass spiral in bulb. On weighted wood base.....**$4.00**

218F. Low Vacuum Tube. Spherical shape with four electrodes. A discharge through this tube traces a path of colored light from the cathode to whichever of the other three terminals is made the anode. On wood base **$7.50**

219F. High Vacuum Tube. Spherical shape with three electrodes. A discharge through this tube shows no visible path between cathode and anode. Fluorescence of the walls of the tube directly opposite the cathode electrode proves that the cathode rays travel across the tube in straight lines....**$7.50**

Spectrum Tubes

These tubes, also known as Plücker Tubes, are ready prepared for use in spectrum analysis and lecture work. They consist of two glass tubes about 7.5 cm. long by 13 mm. diameter joined by a glass capillary about 10 cm. long by 7 mm. diameter. The ends are provided with heavy rod electrodes terminating in a cap and ring on the outside, the latter for convenience in connecting them into circuit. During evacuation a trace of pure gas is introduced into the tube which is then sealed-off at reduced pressure. Operated with a static machine or a small induction coil (like our No. 650E) a bright discharge passes through the tube, varying in color and spectrum with the contained gas. The discharge is especially brilliant in the capillary section where the current density is greatest. In a spectroscope this highly luminous section produces an intensely brilliant spectrum containing the lines characteristic of the gas in the tube. Hence these tubes are especially valuable for use with a grating spectroscope in wave-length determinations, for spectrum analysis by the comparison method, and for acquainting students with the spectra of the better-known gases in their pure form. Overall length, 25 cm.

326F. Spectrum Tube, Argon Gas.....**$5.00**
328F. Spectrum Tube, Bromine Vapor..... 2.00
330F. Spectrum Tube, Carbonic Acid Gas..... 2.00
331F. Spectrum Tube, Chlorine Gas..... 2.00
332F. Spectrum Tube, Helium Gas..... 5.00
335F. Spectrum Tube, Hydrogen Gas..... 2.00
336F. Spectrum Tube, Iodine Vapor..... 2.00
337F. Spectrum Tube, Mercury Vapor..... 2.00
338F. Spectrum Tube, Neon Gas 5.00
340F. Spectrum Tube, Nitrogen Gas..... 2.00
345F. Spectrum Tube, Oxygen Gas..... 2.00
346F. Spectrum Tube, Water Vapor..... 2.00

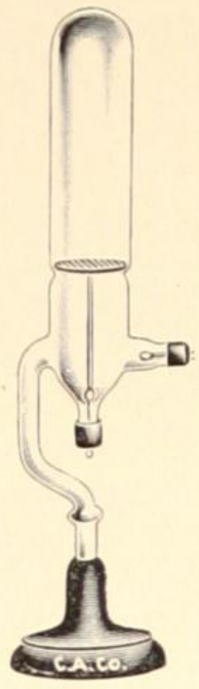
3603F. Fluorescent Liquids. For showing the character of fluorescence exhibited by certain liquids when exposed to sunlight, arc-light, colored light, ultra violet light, etc. Consists of six fluorescent liquids in sealed glass tubes, mounted in a wooden exhibition rack with back and cover, forming a case measuring 21x17 cm. when closed. Each tube is plainly marked with the liquid it contains....**$10.00**

3605F. Phosphorescent Sulphides of Alkaline Earths. For revealing the characteristic phosphorescence of alkaline earth sulphides after exposure to X-rays, radium radiations or ultra violet light. Each sulphide is contained in a flattened glass tube, 11 cm. long, and the five different varieties are assembled in a velvet lined case with hinged lid. Each tube is plainly marked with the name of its content.....**$10.00**

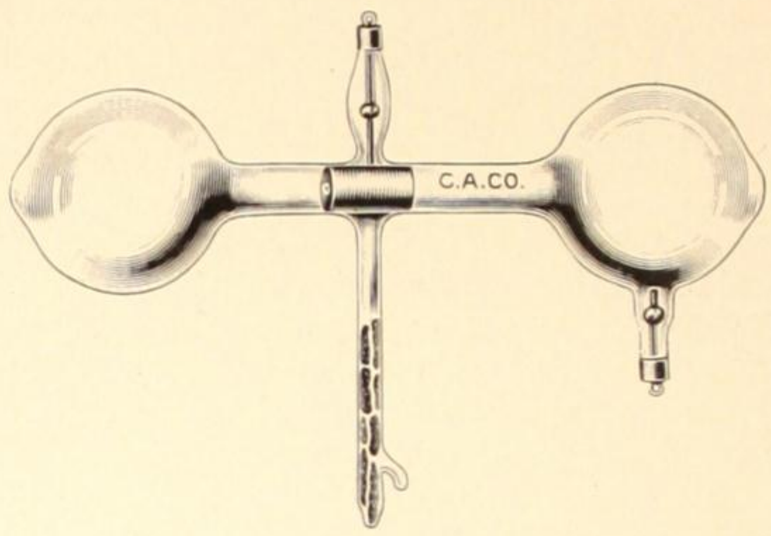
Vacuum Tubes—Cont.



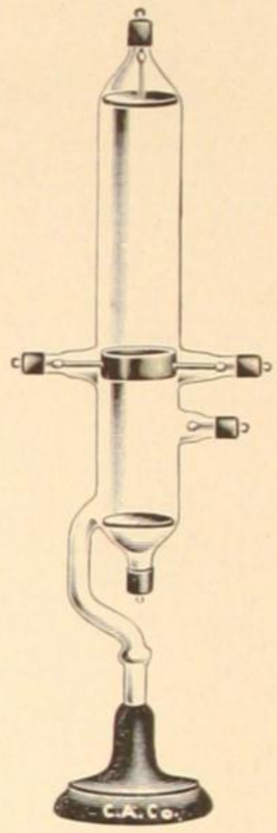
No. 3610F.



No. 3615F.



No. 3620F.



No. 3625F.

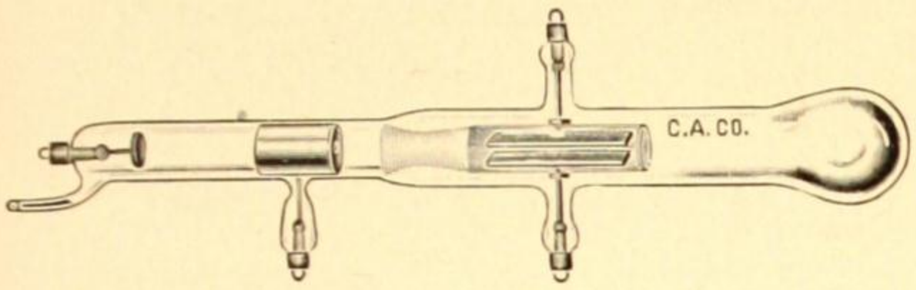
3610F. DeLaRives Apparatus. When a current flows perpendicular to the direction of the lines of force in a magnetic field, rotation will result if the medium through which the current is flowing is free to move. This is due to the force exerted on the current by magnetic field. That the reaction on a discharge through a gas at reduced pressure is the same, is beautifully illustrated by this tube. The lower electrode is in the form of a ring. A sealed-in glass tube permits the extended core of the electromagnet to extend through and beyond this ring. In action, a reddish colored concentrated discharge passes between the electrodes, which when the electromagnet is energized, will rotate about the core. Reversing the polarity of the electromagnet reverses the direction of rotation. From the polarity of the core and the direction of rotation, the direction of the current in the discharge can be deduced. Diameter of bulb, 9 cm.; overall height, 32 cm. Complete with electromagnet **$12.50**

3615F. Canal Ray Tube, Goldstein's. For demonstrating that positive and negative ions appear in a discharge tube; and that the positive form the canal rays observed by Goldstein in 1886, while the negative form the cathode rays. Cathode ray emission is due to a positive ion bombardment on the cathode. The slots in the cathode of this tube permit some of the positive ions to pass into the upper portion of the tube, forming the so-called canal rays. In the field of a powerful electromagnet the canal rays deflect slightly. From the direction of the deflection and of the lines of force, it can be shown that they carry positive charges. The cathode rays in the lower section will under the influence of the same magnetic field, show a much larger deflection in the same direction, indicating that they are negatively charged. Diameter of tube, 4 cm. Overall height, 40 cm. On polished wooden base..... **$11.00**

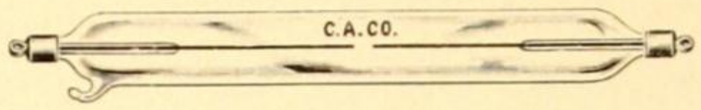
3620F. Canal Ray Tube. For the qualitative study of canal rays (positive rays) and cathode rays (negative rays) as outlined on page 463, "Physics" by Duff, Lewis, Mendenhall, Carman and Knipp. The cathode is a hollow cylinder with a small central aperture in each end, providing a small circular, horizontal path for the rays. The anode is in the tube extending downwards from the bulb at the right. For the further reduction of the vacuum, by immersion in liquid air, the central lower bulb is filled with charcoal. In action, the cathode ray beam emerges from the face of the cathode and reaches the opposite side of the right-hand bulb, where it produces noticeable heating of the glass. Due to the presence of a trace of helium, introduced at low pressure before the tube is sealed-off, the cathode stream presents a greenish-blue color. The positive ions form at the edge of the Crookes' dark space, fall towards the cathode, and a portion passes through the perforated cylinder, forming a stream of positive rays which falls upon the glass at the end of the left-hand bulb, warming it gently. The helium gas gives these rays a distinct reddish color. Placing the poles of a horseshoe magnet astride the horizontal connecting tube to the right of the cylindrical electrode will cause the cathode rays to be completely deflected out of their course. Similarly, if the magnet is placed to the left of the cylindrical electrodes, no appreciable deflection of the positive rays will take place. Bulbs, 10 cm. diameter; overall width, from extremity of one bulb to extremity of the other, about 37 cm. **$30.00**

3625F. Canal Ray Tube, Wien's. For showing the positive and negative charges of cathode and canal rays. In use the perforated plate at the center is earthed, the wire electrode directly below it made the anode, and the disc at the top the cathode. An electroscope is connected to the lower disc electrode. The cathode rays passing through the perforated plate strike the lower disc and the electroscope indicates the flow of negative electricity. If the perforated plate remains earthed and is made the cathode, instead of the top disc, the electroscope now will show the flow of positive electricity. Diameter of tube, 4.5 cm.; overall height, 45 cm. On polished wooden base **$13.50**

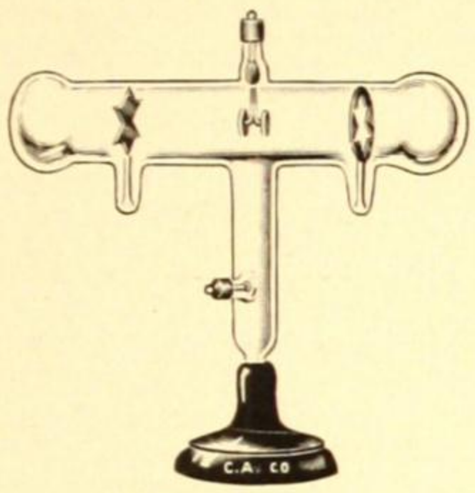
Vacuum Tubes—Cont.



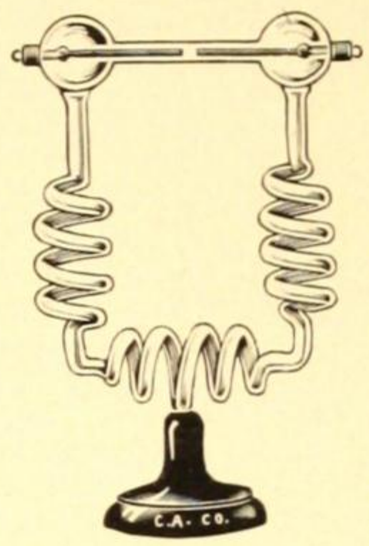
No. 3627F.



No. 3630F.



No. 3635F.



No. 3640F.

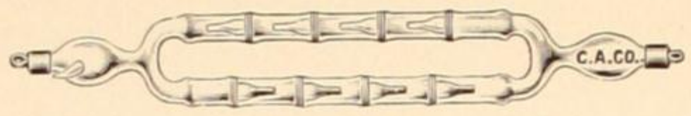
3627F. Vacuum Tube, Thomson's. For determining the velocity and ratio of charge to mass of the electron in cathode rays by the crossed field method. The construction of this highly exhausted tube is such that when excited by a coil or static machine the cathode rays starting from the end electrode pass through a small hole in the metal plug in the narrow neck, thence in a straight line between the two plate electrodes to the far end of the tube. Here the pencil of rays produce a bright fluorescent spot. On introducing an electric field, by connecting a battery to the plate electrodes, the bright spot is deflected vertically. By measuring this deflection e/mv^2 can be determined, e being the charge on the electron, m its mass, v its velocity. If the rays are now also exposed to a magnetic field with the lines of force vertical, the spot will describe a circle. By measuring the radius of this circle the value of e/mv can be found. From the two observations the value of both e/m and v can be calculated. Length, about 50 cm. **$27.50**

3630F. Glow Light Oscillograph Tube, Gehrcke Ruhmer. For the visual study, by the rotating mirror method, of the curve shape of the current alterations in A.C. circuit, condenser discharges, induction coil discharges, etc. Also provides a simple means for determining the frequency of A.C. circuits by noting the mirrror speed, when the latter is adjusted to the point of synchronism. Consists of an evacuated tube, 30 cm. long by 3 cm. diameter, with two axially arranged heavy wire electrodes with a very small gap between them at the center. In action both electrodes appear to be covered with a bluish glow, but actually the glow is only upon the electrode which at the moment happens to be the cathode. This glow is proportional to the momentary current and the curve shape is rendered visible by a rotating mirror. The voltage—110 and 220 volts—of lighting circuits is too low to operate this tube, which responds only to voltages of several thousand or more. To overcome this, the lighting circuit, the frequency of which is to be measured, should be connected to the primary and the tube to the secondary terminals of a transformer like our No. 1041E. Our No. 892R Rotator with Speed Indicator and No. 954R Cubic Mirror will give excellent results in connection with this tube..... **$6.00**

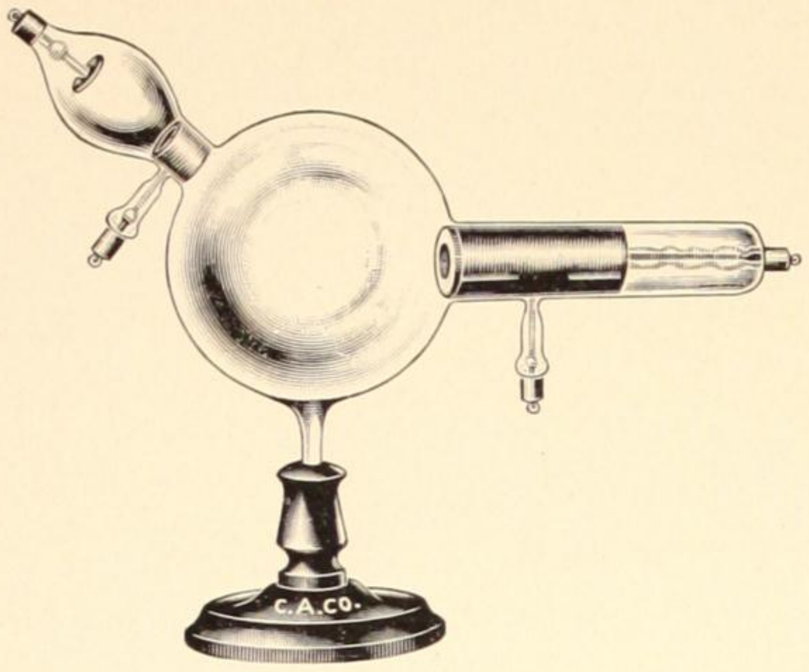
3635F. Puluj's Double Shadow Tube. Similar to No. 25F, but with two crosses, one solid, the other cut-out. The cathode electrode, at the center, is of the double-disc type. When this tube is excited with a coil or static machine the shadow of both crosses appear simultaneously at the enlarged ends. The shadow of the solid cross appears as a dark pattern surrounded by fluorescent glass, while the other appears as a fluorescent pattern with a dark shadow around it, making a very striking demonstration. Length, about 28 cm.; overall height, 25 cm. On wooden stand **$10.00**

3640F. Hittorf's Tube. For showing that resistance and not distance determines the path of a discharge through a vacuum tube. In this tube, of rectangular shape, two paths between the electrodes are provided; one very short, the other very long. The vacuum is so adjusted that the short path lies wholly within the Crookes' dark space, the resistance of which is extremely high because of the absence of gaseous ions in this space. Hence, when the tube is excited with a coil or static machine, the discharge takes the long path through spirals—the path of least resistance—instead of the extremely short path directly between the electrodes. Height 26 cm. On wooden stand **$9.00**

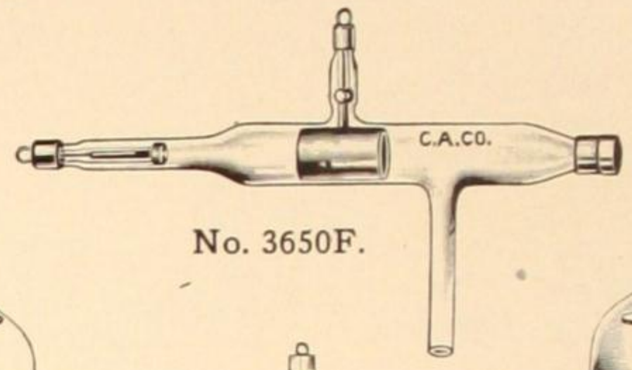
Vacuum Tubes—Cont.



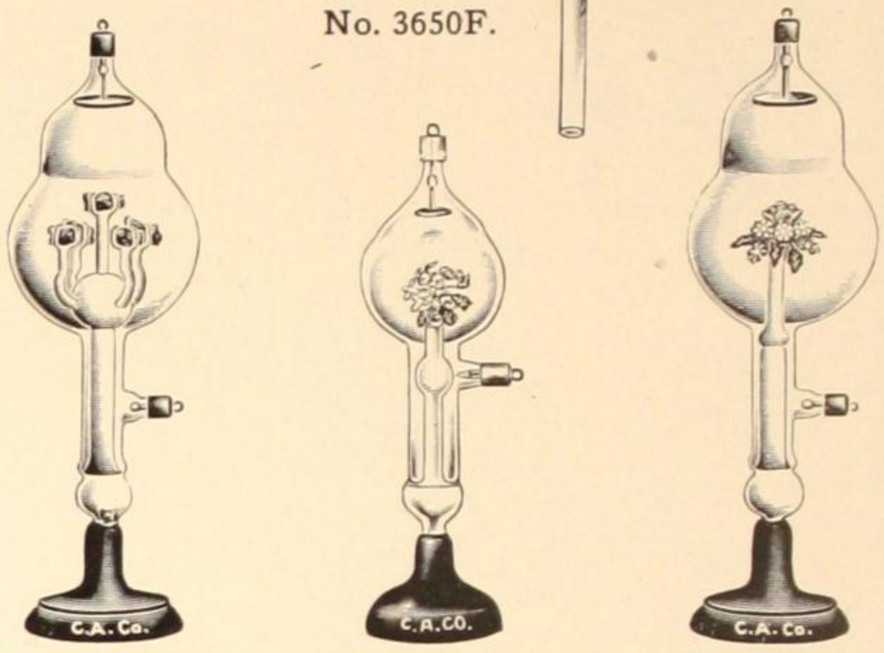
No. 3645F.



No. 3655F.



No. 3650F.



No. 3660F. No. 3665F. No. 3670F.

3645F. Holtz's Tube, Double. In this tube, the tapered openings in the partitions of one arm point in one direction, and in the other arm in the opposite direction. When a high potential alternating current is impressed on the terminals, the discharge passes through one arm only. This is indicated by the bright glow in one arm and the absence of glow in the other. Reversing the discharge causes the flow to take place in the other arm. The discharge of a coil with a current breaker in the primary, will because of the wide differences of potential at make and break, cause both arms to glow. However, the glow in one arm is far more intense than in the other. Because of the manner in which this tube functions it is useful for revealing the extent to which the discharges in opposite directions in high frequency currents approach equality. For the same reason the tube is also useful for suppressing the low voltage make potential of an induction coil discharge. When used for this purpose in series with another vacuum tube, the latter is under the excitation of the high voltage break potential only. Thus, the second tube, operating at maximum efficiency, yields the most brilliant results which it is capable of producing **$5.00**

3650F. Lenard's Tube. For showing that cathode rays can be passed from the inside of a discharge tube, through thin aluminum foil, to the air outside. The cathode is an aluminum disc fastened to a stiff wire surrounded by a glass tube, which in turn is surrounded by a metal strip comprising the anode. The end of the tube is closed by a stout metal cap in the middle of which is a small hole covered with very thin aluminum foil which can be readily renewed when necessary. In use the terminals are connected to an induction coil, the cap and anode grounded, and the tube evacuated with a high vacuum pump until a diffuse light, visible in a dark room, spreads from the aluminum foil window into the outside air for a distance of several centimeters.

From the window also proceed the so-called Lenard rays, which like cathode rays can produce fluorescent effects on zinc sulphide, X-ray screens, etc. They will affect photographic plates, ionize gases, and change the color of haloid salts of the alkali metals. They can also be deflected by a magnet. Length, about 35 cm.

Without stand **$12.50**

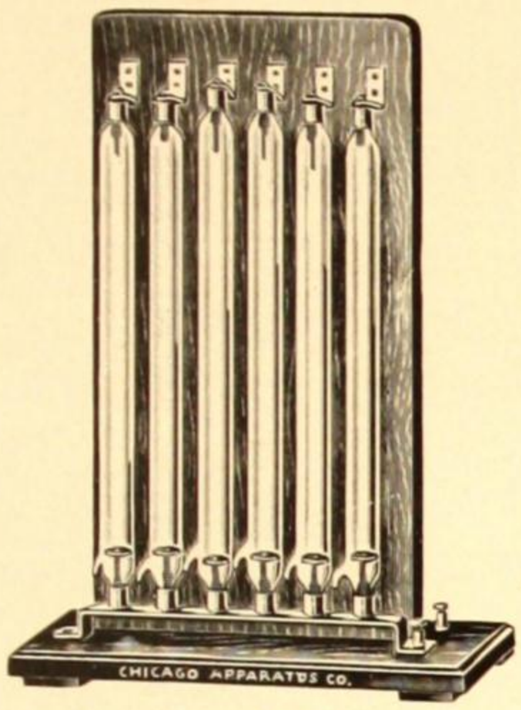
3655F. Vacuum Tube, Perrin's. For showing that cathode rays carry negatively charged particles. The flat electrode at the left extremity is the cathode. The perforated metal plug electrode directly in front of the cathode is the anode. In action a narrow beam of cathode rays is projected against the walls of the glass bulb, directly opposite the perforated anode and just below the two coaxial metal cylinders in the tube at the right, where it produces a bright fluorescent spot. If the outer of the coaxial hollow cylinders is grounded, the inner connected with an electroscope, and the cathode ray deflected vertically by a magnet, so that the bright spot disappears in the inner hollow cylinder, the electroscope will indicate that it has received a negative charge. Diameter of bulb, 15 cm. On finely finished wooden stand **$20.00**

3660F. Vacuum Tube, with Fluorescent Minerals. Within the bulb are mounted five different minerals, each securely held in strong glass prongs. Directly above them is a disc cathode electrode. In action a stream of cathode rays impinges upon the minerals, causing each to fluoresce with its characteristic color and brilliancy. Overall height, 36 cm. On finely finished wooden stand..... **$10.00**

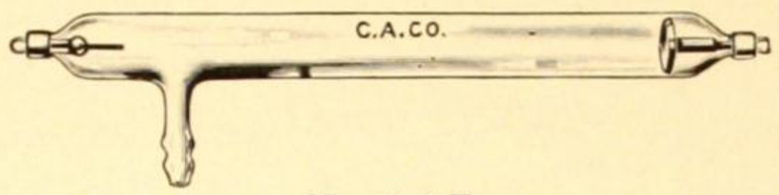
3665F. Vacuum Tube, with Two Roses. This tube contains fluorescent minerals arranged and mounted to represent two roses. Directly above them is a disc cathode electrode. Under the action of cathode rays these flowers become luminous, glowing in the beautiful fluorescent colors characteristic of the minerals from which they are made. In the dark the effect is greatly enhanced. Overall height, 27 cm. On polished wooden stand..... **$4.00**

3670F. Vacuum Tube, with Bouquet of Flowers. Under the stimulus of cathode rays certain minerals exhibit more pleasing and more colorful effects than others. In this tube the choicest minerals are artistically arranged to resemble a bouquet of flowers. Directly above is a disc cathode electrode. When the tube is excited by a static machine or coil, the bouquet glows brilliantly, each mineral contributing its own characteristic color and intensity. In the dark the beauty of the effect is greatly enhanced. Overall height, 36 cm. On polished wooden stand.... **$12.00**

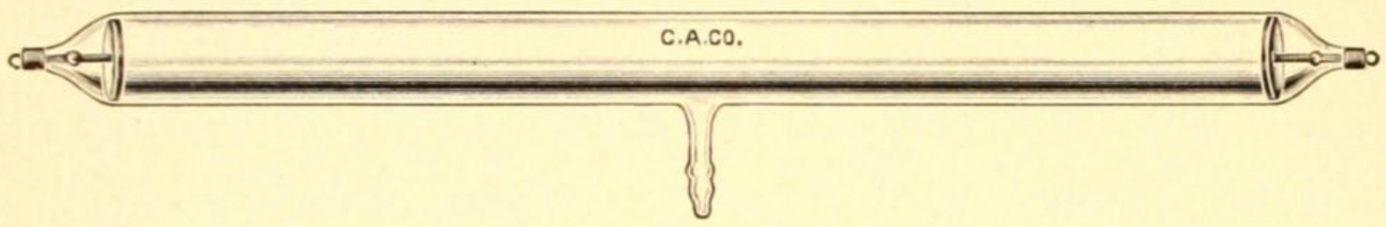
Vacuum Tubes—Cont.



No. 3675F.



No. 3682F.



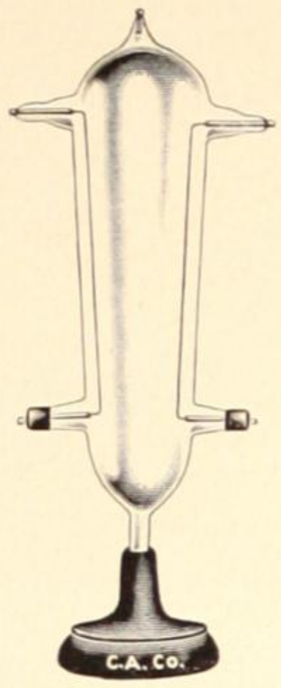
No. 3680F.

3675F. Vacuum Scale. Six vacuum tubes for revealing the character and appearance of electrical discharges through gases at reduced pressures. The tubes are mounted on a wooden frame provided with terminals for connection to the high potential current source. A movable contact lever at the back directs the discharge through the desired tube. The manner of mounting makes demonstrations easy and effective. The degree to which each tube is evacuated and the effects it produces in action are as follows: No. 1. 40 mm. vacuum. Numerous violet streamers pass between the electrodes and there is a distinct, though small glow at the cathode. No. 2. 10 mm. vacuum. The discharge through the tube has become concentrated in a single vivid red colored, luminous streamer along the axis of the tube. No. 3. 6 mm. vacuum. The luminous band has expanded and fills the tube except for a dark space near the cathode. No. 4. 3 mm. vacuum. Shows shifting layers or striae. The dark space has increased in length and become divided into two parts separated by a luminous partition. No. 5. 0.14 mm. vacuum. The tube is well filled with brilliant light and the glass upon which the cathode rays impinge exhibits a greenish-yellow fluorescence. No. 6. 0.03 mm. vacuum. The tube is filled with a pale blue light and the glass exhibits a strong fluorescence, greenish in color, characteristic of the X-rays which are produced at this low pressure. Complete, as illustrated, with six-point lever switch on the back of the frame for quickly introducing the desired tube into circuit, without changing the lead wires. . **$20.00**

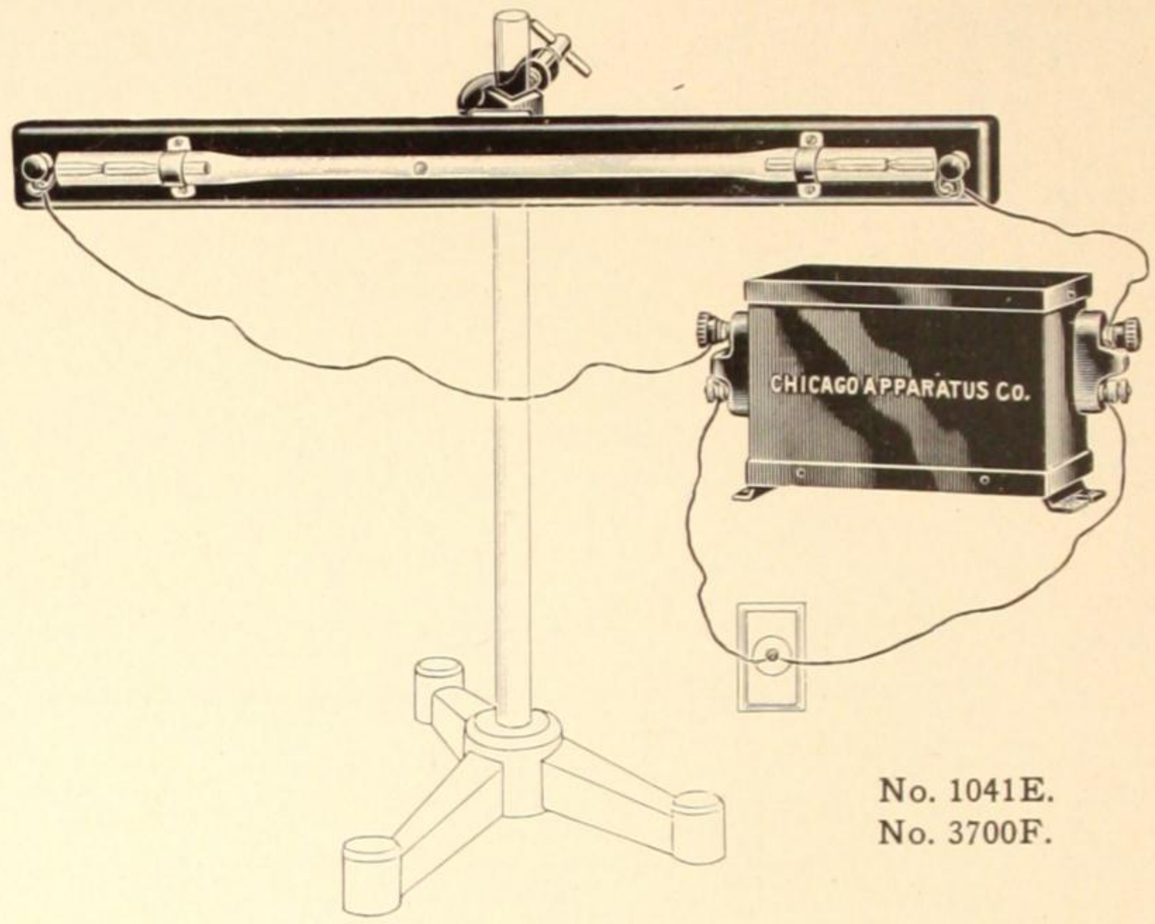
3680F. Vacuum Discharge Tube, Lecture Demonstration Type. For demonstrating the phenomena attending the discharge between electrodes under reduced pressures. The tube is approximately 80 cm. long x 5 cm. inside diameter and is provided at either end with large flat aluminum electrodes. A side branch is provided for clamping the tube to a stand and for making connection, by means of rubber tubing, to the vacuum pump. In use an induction coil furnishing a discharge of about ¾-inch spark length, like our No. 650E, is connected across the electrodes. At atmospheric pressure no discharge passes between the electrodes; at 100-150 mm. of mercury bluish threads of light trickle along the walls of the tube; at 30-40 mm. the threads of light thicken and travel for the most part through the gas; at 0.1 mm. the cathode glow and Crookes and Faraday dark spaces have put in their appearance; at 0.04 mm. the Crookes and Faraday dark spaces widen; at 0.001 mm. the Crookes dark space is well developed and the glass exhibits brilliant fluorescence. At still lower pressures the vacuum becomes "hard," the diminishing brilliancy indicating the flow of less and less current. (See page 453, "Physics," by Duff, Lewis, Mendenhall, Carman and Knipp) **$15.00**

3682F. Vacuum Tube with Concave Electrode. For demonstrating in a more striking manner the phenomena associated with the discharge of electricity through gases at reduced pressure. The cathode, of aluminum, is concave and has a radius of curvature of about 5 cm. The anode is a cylindrical aluminum rod. The tube measures 44 cm. long by 3.5 cm. in diameter and is provided with an open side tube for connection, by means of a rubber tube, to a vacuum pump. With the terminals connected to an induction or static machine, and the pressure within the tube reduced to .02 mm. of mercury many interesting effects are exhibited, such as: Crookes' dark space, Faraday's dark space, Negative glow, Positive column, X-Ray fluorescence where the cathode rays impinge on the walls of the tube. Path of cathode rays to a focal point at the center of curvature of the cathode electrode. By deflecting the cathode rays with a magnetic field other striking effects are produced **$10.00**

Vacuum Tubes—Cont.



No. 3685F.



No. 1041E.
No. 3700F.

3685F. Greinacher's Series-Ladder Discharge Tube. For showing that the discharges of induction coils and static machines are not continuous, but consist of a series of separate sparks. This tube is pear shaped, partially exhausted, and provided with two wire electrodes arranged so as to form a gap of gradually increasing size. When a discharge passes through this tube, the first spark naturally jumps across the shortest distance between the electrodes—at the bottom. The passage of the spark ionizes and heats the gas along its path, the heating causing the ionized gas to rise. The next spark, instead of jumping across the shortest gap, will pass through the longer displaced path of ionized air because of the lower resistance of the latter. In like manner each succeeding spark will traverse a longer and higher path between the electrodes, until the top is reached, when the whole performance starts anew from the bottom again.

Viewed from a short distance, the action of this tube is that of a spark "climbing" up an invisible ladder. The action is entirely automatic and striking and impressive in the extreme. By photographing the complete series of spark jumps—from across the smallest to the largest gap—the character of the individual sparks can be studied, and the difference between static machine and induction coil discharges revealed. Overall height, 35 cm. On wooden base **$13.50**

Neon Sign Demonstration Apparatus

With the apparatus listed below, constructional details of Neon Illuminated Signs can be shown and the principles upon which they operate demonstrated.

The tube has an overall length of 50 cm. with a luminous section 30 cm. long by 13 mm. in diameter. Every detail of the large and elaborate electrodes are clearly revealed. The tube is mounted on a blackened wood back, 55x5 cm. against which the glow of the tube will stand out in bold contrast, even in a lighted room. On this back are also two insulating-head binding post terminals, and a clamp for attaching the whole to a support. The central section glows intensely with the color so characteristic of neon signs—red or blue—when excited by the secondary voltage of the transformer.

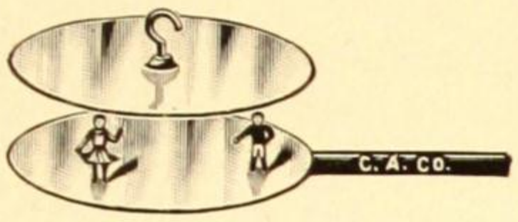
The transformer is designed to operate on 110 volt, 60 cycle, A.C. lighting circuits and delivers a secondary current of 5,000 volts and 25 milliamperes, which is correct for properly exciting this tube. This transformer is also suitable for exciting Geissler and other vacuum tubes; however, when used for this purpose, the primary current should be reduced by means of a rheostat or lamp bank, as the full output is apt to injure the lightweight electrodes of such tubes.

3700F. Neon Sign Tube. Length 50 cm., with luminous section 30 cm. x 13 mm. on blackened wood back with insulating-head binding posts and clamp for attaching to support **$6.00**

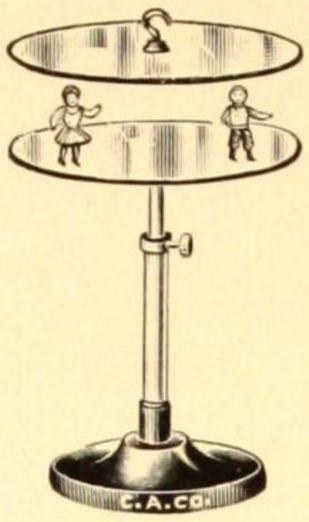
1041E. High Potential Transformer. For operation on 110 volt, 60 cycle A.S. lighting circuit. Secondary output, 5,000 volts and 25 milliamperes **$12.50**



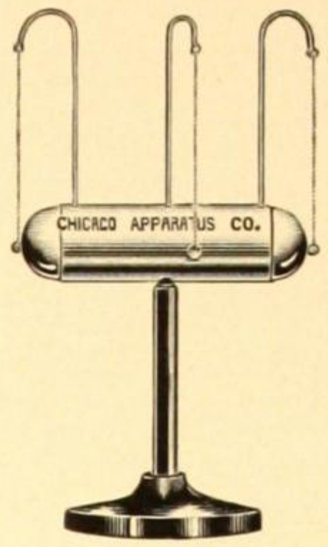
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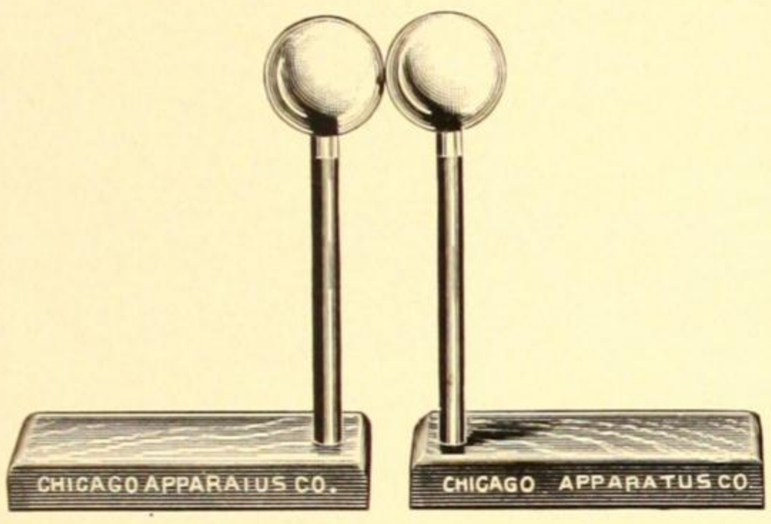
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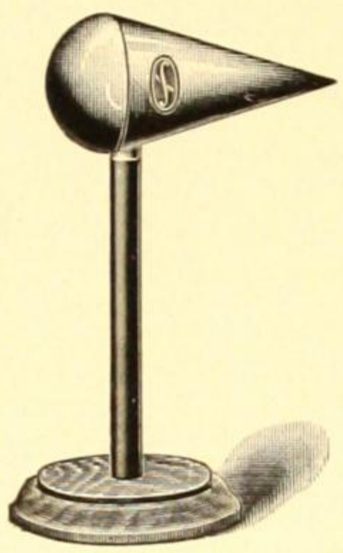
No. 226F.



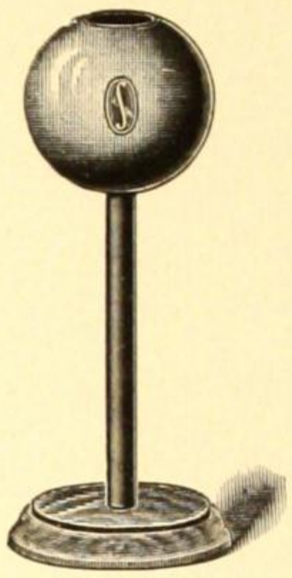
No. 235F.



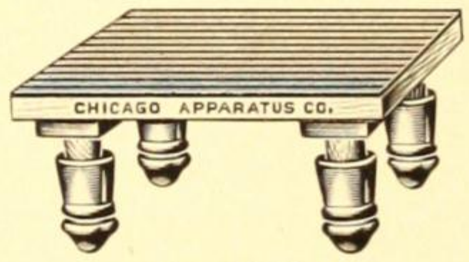
No. 240F.



No. 245F.



No. 250F.



No. 252F.

220F. Hollow Cylinder with Extra Large Pith Balls 13 to 14 mm. Diam. For showing that electric charges reside only upon the outside surface of conductors. Cylinders of brass, nickel-plated; 5 cm. diameter, 6.5 cm. long, provided with pith balls outside and inside, mounted on insulating stand.... **$2.25**

225F. Image Plates. Two six-inch nickel-plated metal disks, one with handle, the other with ring for suspending from the knob of a static machine. When pith balls or pith images are placed between these plates, one of which is connected with the earth and the other to one knob of a static machine in operation, the figures will bound back and forth between the plates as long as machine is operated. **$2.50**

226F. Image Plates, Mounted. Same as No. 225F, but with lower plate on adjustable insulating stand. **$3.75**

290F. Images, Pith. Light pith figures, about 2 cm. high, for use with No. 225F and No. 226F Image Plates ..... **Per pair $0.75**

235F. Induction Cylinder with Three Suspended Pith Balls. For studying the nature of electrification of an induced charge; that the density of an electric charge is greatest where the curvature of the surface is greatest—at the ends; and for demonstrating the absence of a charge at the middle. Brass, nickel-plated, 5 cm. diameter, 20 cm. long, with three removable holders from which pith balls are suspended from silk threads **$4.00**

240F. Induction Spheres. Nickel-plated brass, 5 cm. diameter, on insulating supports, so mounted that they can be brought into contact with each other. Excellent for use in connection with No. 235F Induction Cylinder for showing separation of positive and negative electricity by induction..... **$4.50**

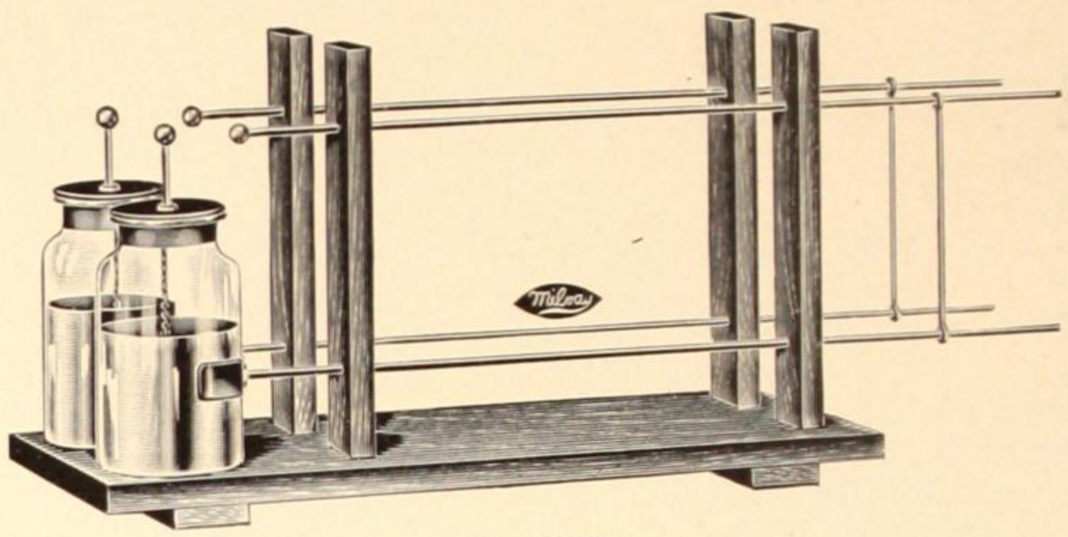
245F. Insulated Conductor, Ellipsoidal. For showing unequal distribution of an electric charge. Brass, nickel-plated, 10 cm. diameter, 15 cm. long, on insulating stand. Overall height, about 26.5 cm... **$5.50**

250F. Insulated Hollow Globe. Brass, nickel-plated, about 10 cm. diameter, on insulating stand, with hole in top for proof plane, for showing that an electric charge resides only on the outside of a conductor. Diameter of opening, 32 mm. Overall height, 26.5 cm. **$4.00**

252F. Insulating Stool. Made of finely finished hardwood, 30x36 cm., with heavy glass legs. The top is covered with a layer of black corrugated sheet rubber, providing a surface that will not mar when stood upon. Furthermore, it provides additional insulation **$4.50**



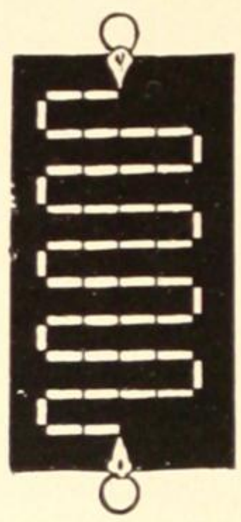
Nos. 255F-256F.



No. 265F.



No. 260F.



No. 270F.



No. 1288C.

255F. Leyden Jar, Milvay Improved, Pint Size. The construction of Leyden jars has undergone no material change since they were first devised. They have always had one inherent weakness, to which users have become reconciled as a matter of course—the quick wear and tear on the delicate outer tin foil coating. After considerable experimenting, we have found that this disadvantage could be entirely eliminated by applying a heavy coating of a special flexible aluminum lacquer to the bottom and sides, as shown in the illustration. This lacquer provides a hard scratch proof surface, which absolutely prevents the wear and tear which would otherwise occur in handling and storing the jars.

Other details of construction are: Special condenser glass, fiber top, nickel plated rod with knob top, and inner coating of tin foil. Jar measures 15 cm. high by 7.5 cm. diameter. From a standpoint of performance and service this Milvay Improved Leyden jar is unquestionably the best on the market today **$2.50**

256F. Leyden Jar, Milvay Improved, Quart Size. Same construction as No. 255F, but with jar measuring 19 cm. high and 10 cm. in diameter..... **$3.00**

260F. Leyden Jar. With Removable Coatings, Large Size. For proving that the coatings of a Leyden jar act simply as a means for collecting the charge, and that the seat of the charge is in the glass. Consists of a cone-shaped glass jar, 16 cm. high, 11 cm. diameter at top; metal inner coating with nickel-plated rod and knob, and metal outer coating.. **$4.00**

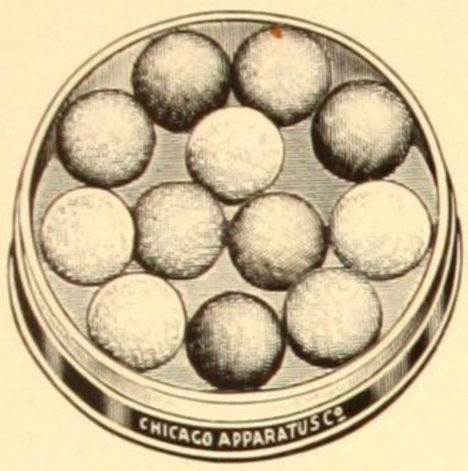
265F. Leyden Jars, Resonant. Milvay. For demonstrating that two electrical circuits, like two tuning forks, can be tuned so as to respond to each other sympathetically. When one jar is successively charged and discharged by means of a static machine or induction coil a spark will appear at the other jar, provided the areas of both loops are the same. When one loop is considerably larger or smaller than the other the second spark disappears.

Two-quart size Leyden jars mounted on 25x60 cm. hardwood base with two adjustable metal loops **$15.00**

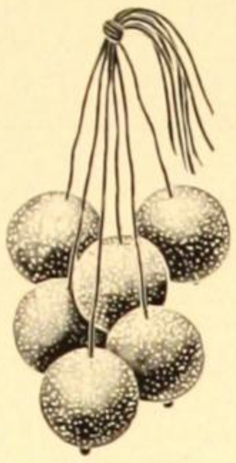
270F. Lightning Plate. Consists of an ebonite plate, 10x19 cm., with a strip of tin foil—separated by numerous small gaps—on it, and provided with a connection ring at the top and at the bottom. For use with No. 515F Support and No. 210F Holder. A discharge from a static machine sent across the plate will show a series of sparks at the gaps..... **$1.50**

1288C. Ozone Apparatus, Siemen's. A simple, efficient lecture-table apparatus for converting oxygen into its allotropic form—ozone. The double-walled glass tube is coated inside and outside with foil. If the outside coating is connected with one pole of an induction coil or static machine, and the inside coating with the other, a silent discharge will pass between the coatings. This electrical discharge passes through the oxygen (contained in the air) flowing through the double-walled tube, converting it into ozone.

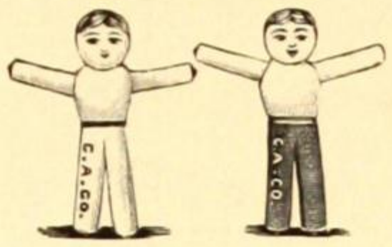
On finely finished 40x14 cm. hardwood base, with binding post terminals..... **$7.50**



No. 275F.



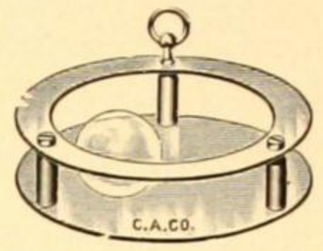
Nos. 280F.-285F.



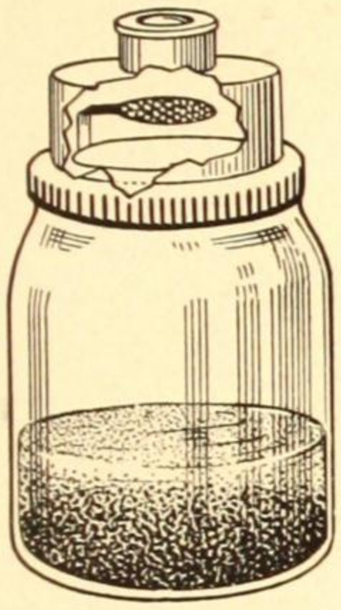
No. 290F.



No. 295F.



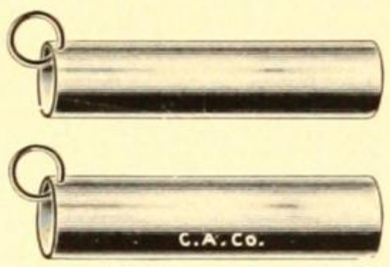
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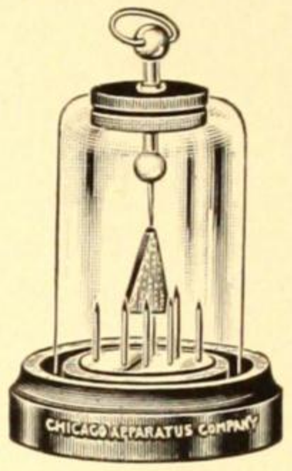
No. 305F.



No. 310F.



No. 315F.



No. 325F.

275F. Pith Balls. Colored, very fine, diameter 5 to 6 mm. Twelve in box.....**Per box $0.50**

280F. Pith Balls. Same as No. 275F, but with silk suspension cords 6 inches long. Six in package. **Per package** **$0.50**

285F. Pith Balls. Same as No. 280F, but covered with aluminum paint, making them very sensitive. Six in package.....**Per package $0.60**

290F. Pith Images. Light pith figures about 2 cm. high, for use with No. 225F and No. 226F Image Plates .....**Per pair $0.75**

295F. Proof Plane. A small nickel-plated brass disc with ebonite insulating handle 13 cm. long. For conveying charges from one body to another; also for conveying charges, from various parts of conductors, to determine the nature and density of electrification **$0.25**

300F. Racing Ball. Consists of a metal disc 15 cm. diameter, above which is mounted a metal ring on insulating posts; and a hollow 30 mm. glass ball. Designed to fit on No. 515F Support. When disc is connected to one knob of a static machine in operation, and the insulated ring to the other knob, the glass ball races around the disc.....**$2.50**

305F. Radioscope. For detecting the presence of radio-activity in waters, ores, etc., by the scintillation method. Any active material placed in the bottom of the instrument rises into the upper part and there comes in contact with a screen of phosphorescent zinc sulphide, and produces scintillations, which are observed through an adjustable compound lens of high magnifying power. With each Radioscope is supplied a quantity of high-grade carnotite (radium ore), which will show the scintillating effect of the radium rays. Size 11x6 cm.....**$10.00**

310F. Rotating Disc. An ebonite disc, 8 cm. in diameter, mounted on a pivot between two metal knobs. Designed to fit on No. 515F Support. Rotates rapidly when connected to a static machine in operation **$3.50**

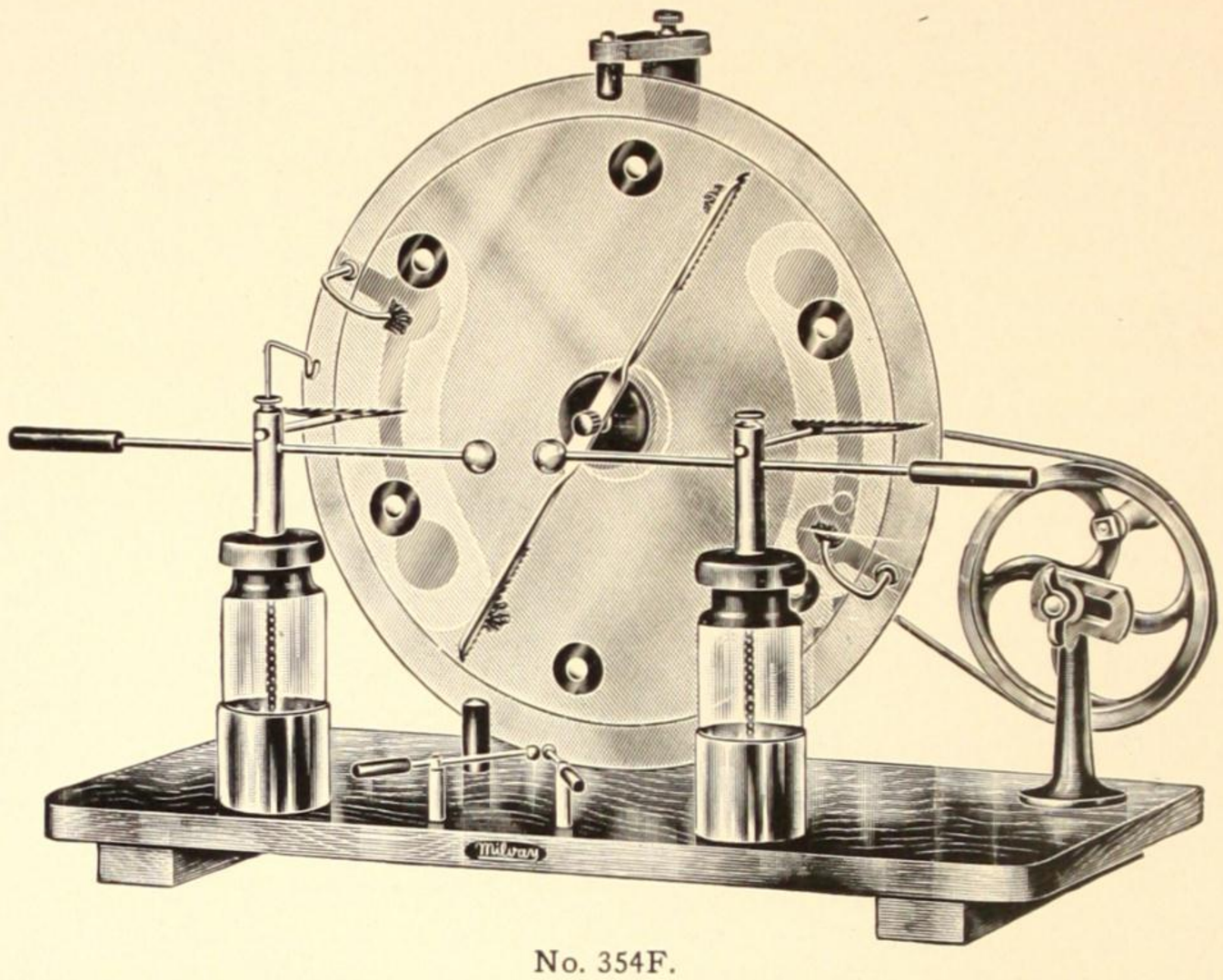
315F. Shocking Handles. Nickel-plated brass tubes, 7.5 cm. long, provided with ring at one end for attaching a chain of wire from static machine. **Per pair** **$0.75**

320F. Smoke Candles. Three in a tin box, for use with No. 325F Smoke Condenser.....**$0.20**

325F. Smoke Condenser. Consists of a wood base with a multiple needle electrode on its bottom, and another inside near the top of the 6x8.5 cm. glass shade. Designed to fit on No. 515F Support. Smoke under the shade is condensed on the glass when a current from a static machine is applied. Including three smoke candles.....**$2.50**

350F. Spintharoscope. For showing the radiant energy of radium salt which is placed at one end of the instrument. At the other end is a high-grade adjustable lens for observing flashes of light as the radium rays strike the screen. The intensity of the radiation is so great that the scintillations are very thick. The Spintharoscope measures 16x18 mm.....**$2.00**

Milvay Toepler-Holtz Machine



No. 354F.

354F. Static Machine, Milvay Toepler-Holtz. Improved form with adjustable collector combs.

Positively the most powerful machine of its kind on the market. Produces a long, thick, energetic, crashing spark. Different and better than any other Toepler-Holtz Machine made. Has larger plates, too. Unlike other models, buttons of revolving plate are placed as near to edge as possible to insure maximum efficiency.

Brushes are new in design. Tinsel in all machines wears away in time. New tinsel can be inserted in the Milvay, by anyone, in a few moments' time, and without use of tools of any kind.

All leather belts stretch from use. In the Milvay it is not necessary to shorten the belt—any stretching can be instantly taken up by our quick acting easy belt tension adjuster.

The Milvay is easy to operate. All bearings, being fitted with the utmost care and accuracy, are surprisingly free from friction.

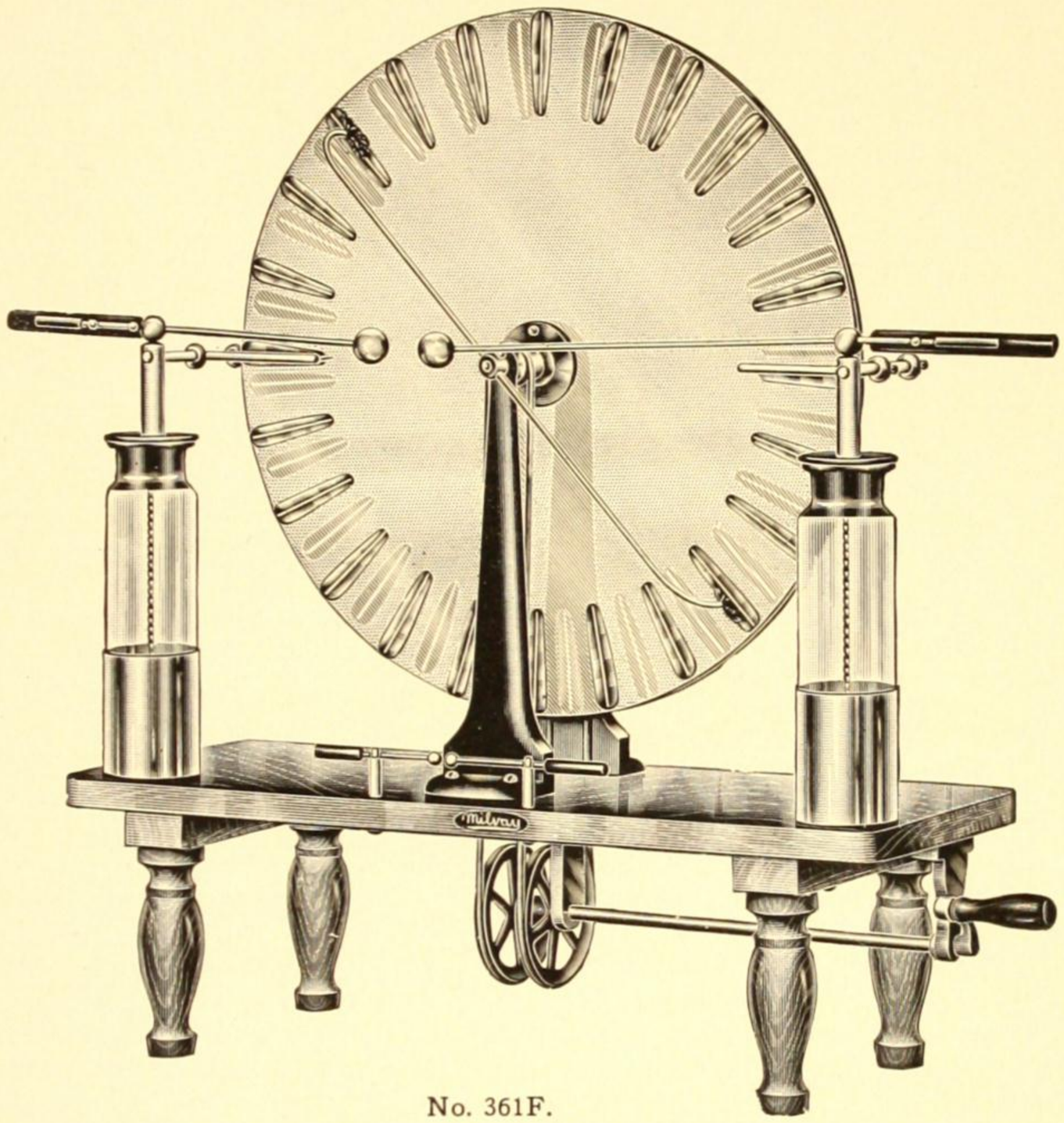
With current breaker mounted on base between Leyden jars the intensity and rapidity of discharge can be varied. You'll find this a great convenience in many experiments.

The workmanship and finish of the Milvay is the best. Pillar and base are of finely finished hardwood. Specially prepared glass plates. Revolving—12 inches diameter. Stationary—14 inches diameter.

Buttons on revolving plate are of aluminum. They will always stay bright and will always make good brush contact. Insulators—finest quality genuine "Diamond" hard rubber. Leyden jars of best condenser glass and properly foiled.

After a long series of tests we positively guarantee that the Milvay Static Machine will give a thick, energetic, crashing spark three inches long, regardless of weather conditions. Under good conditions the Milvay will easily deliver a much longer spark. Under ideal conditions sparks six inches long have been obtained with ease. On 11x22 inch hardwood base **$32.50**

Milvay Wimshurst Machine (Large)



No. 361F.

361F. Static Machine, Milvay, Wimshurst. Self-charging. Improved form, with indestructible aluminum sectors which are not affected by brush action.

This machine is not affected by moisture and works without change of poles. In this respect it is superior to a Toepler-Holtz or other static generator in which the poles are apt to reverse at any moment. Because of this fact the Milvay Wimshurst Machine is especially well suited for X-Ray work. Every Milvay Wimshurst Machine is provided with an **Adjustable Spark Gap Attachment** for use in X-Ray work.

The outer coats of the Leyden jars may be connected or disconnected by the Current Breaker mounted on the base. Therefore, either a continuous or intermittent discharge can be taken from the machine.

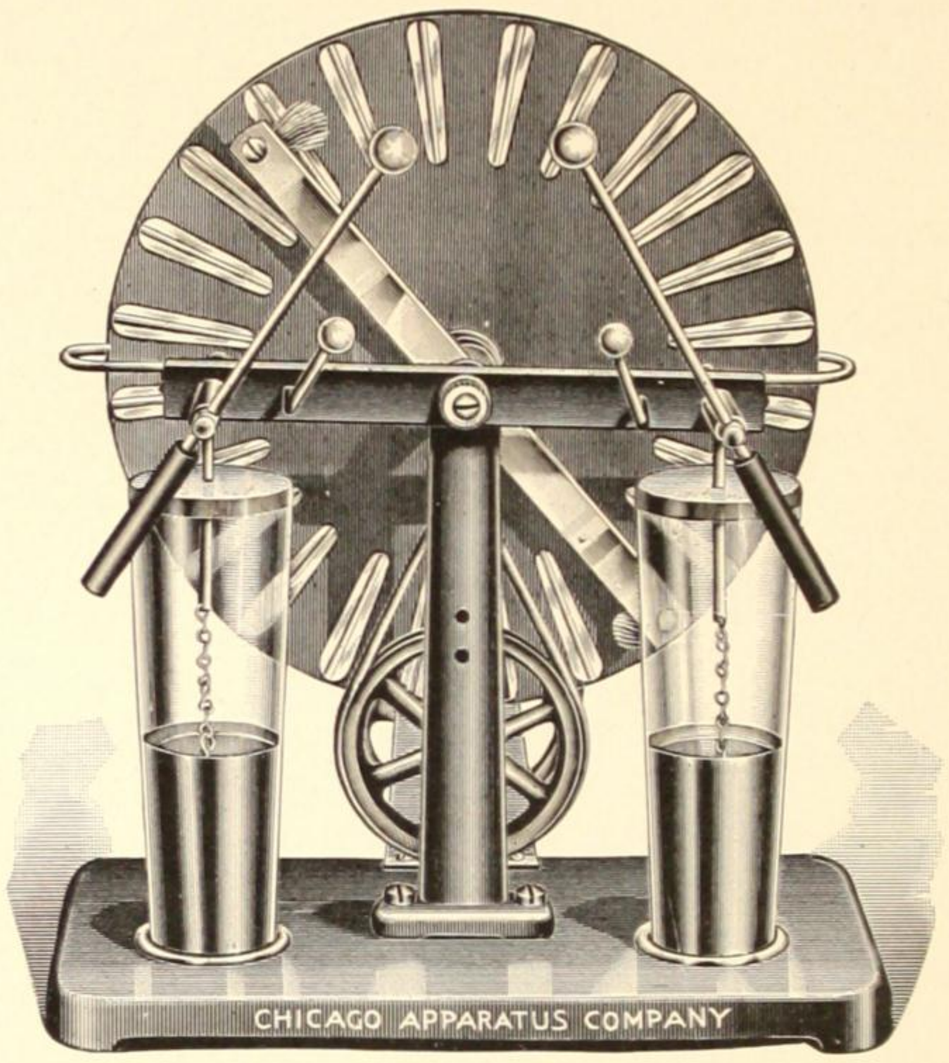
Sparks up to 7 inches long guaranteed.

Base—hardwood, finely finished, 12x28 inches; black enameled iron supports; insulators—pure, hard rubber; brass parts—nickel-plated.

Specially Prepared Glass Plates—18 inches in diameter with indestructible aluminum sectors **$70.00**

362F. Static Machine, Milvay, Wimshurst. Same as No. 361F, but with glass plates 12 inches in diameter. Will produce a spark discharge 2½ to 3½ inches long which is suitable for all, except X-Ray, lecture work **$35.00**

Milvay Wimshurst Machine (Small)



No. 364F.

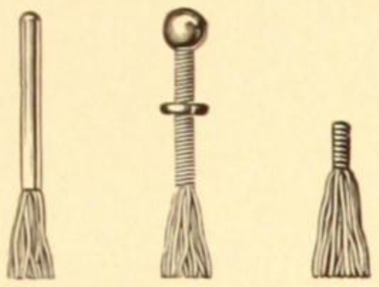
364F. Static Machine, Milvay, Wimshurst, with 8-inch Plates.

We can now offer our patrons a small Wimshurst Machine that is the acme of perfection. The sectors are made of thinnest aluminum sheets fastened to the specially prepared glass plates. They cannot wear. On the old models the brushes wear off the soft tin foil sectors and distribute small particles of tin foil over the plates until the sectors are short circuited and the machine cannot work. This is impossible with our new sectors. The plates will always be found to be in perfect condition no matter how long the machine may have been used.

The ridge in the sectors insures a better contact with the brushes. The charges on these ridges are more powerful, consequently the spark generated by the machine is larger and heavier than usual. Besides, this ridge forms a recess between the plate and the sector into which the special cement flows, holding the sectors firmly in place.

The base is of hardwood, all metal parts nickel-plated brass. The Leyden jars are of the best imported make and their capacity adjusted so as to yield the maximum efficiency of the machine. A pair of adjustable hooks mounted on the horizontal hard rubber bar permit of forming any size "gap." The "gap" varies the intensity and rapidity of the discharge and is absolutely necessary in a great many experiments with accessory apparatus. Under any conditions a heavy spark two and one-half inches long is readily obtainable. Mounted on 18x30 cm. hardwood base **$22.00**

Static Machine Repair Parts



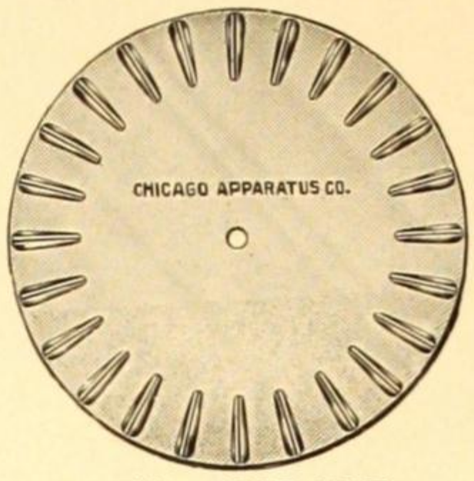
No. 385F. No. 390F. No. 395F.



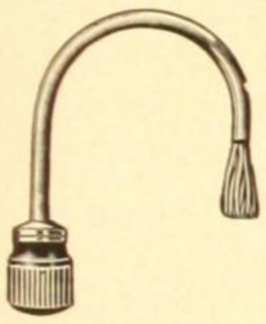
Nos. 440F-450F.



Nos. 460F-470F.



Nos. 485F-500F.



No. 400F.



No. 410F.



No. 425F.



No. 435F.



No. 502F.

375F. Belting. Leather, round, 1/8 inch diameter. Per foot **$0.06**

376F. Belting. Leather, round 3/16 inch diameter. Per foot **$0.07**

377F. Belting, Leather. Round, 1/4 inch diameter. Per foot **$0.15**

378F. Belting, Leather. Round, 5/16 inch diameter. Per foot **$0.20**

381F. Belt, Leather. To fit on No. 354F Toepler-Holtz Machine, for replacement. Of round leather belting, complete with metal connecting link... **$0.45**

382F. Belt, Leather. To fit on No. 361F Wimshurst Machine, for replacement. Of round leather belting, complete with metal connecting link..... **$0.85**

383F. Belt, Leather. To fit on No. 362F Wimshurst Machine, for replacement. Of round leather belting, complete with metal connecting link..... **$0.75**

384F. Belt, Leather. To fit on No. 364F Wimshurst Machine, for replacement. Of round leather belting, complete with metal connecting link. (Machine has two belts, both alike). **Each**..... **$0.35**

385F. Brush, Plain Shank. With tinsel. For Toepler-Holtz machine **$0.35**

390F. Brush, Threaded Shank. With knob, nut and tinsel. For Toepler-Holtz machine..... **$0.40**

395F. Brush, Tinsel Only. Ready to insert in any static machine brush **$0.12**

400F. Brush Arm. To fit on Stationary Plate of No. 354F Toepler-Holtz Machine. Complete with tinsel brush and thumb-nut for fastening. **Each**..... **$0.50**

405F. Disc with Button. One piece, aluminum, diameter 1 3/8 inches, for revolving plates of Toepler-Holtz machines **$0.10**

410F. Leyden Jar. To fit on No. 354F Toepler-Holtz Machine, for replacement. Glass jar, 2 inches diameter, 5 1/4 inches high; with cap, connecting rod, outer metal coating and inner tin-foil coating..... **$3.00**

420F. Leyden Jar. Same as No. 410F, but with inner tin-foil coating only **$1.75**

425F. Leyden Jar. To fit on Nos. 362F or 364F Wimshurst Machines for replacement. Glass jar, 2 inches diameter, 5 1/4 inches high; with cap, connecting rod, and inner and outer tin-foil coatings..... **$1.50**

435F. Leyden Jar. To fit No. 361F Wimshurst Machine, for replacement. Glass jar, 2 3/8 inches diameter, 8 inches high; with cap, connecting rod, outer metal coating and inner tin-foil coating..... **$3.50**

Note: The glass plates listed below are ready for use. The surfaces are treated to obviate trouble from moisture and imperfections. The revolving plates are furnished with six buttons attached; the stationary plates with two tin foil sectors and paper armatures attached; and the plates for Wimshurst machines with twenty-four ribbed aluminum sectors attached.

440F. Plate, Revolving, Glass. Diameter 10 1/2 inches, center hole 1 inch (for use on Toepler-Holtz machine, with 12-inch stationary plate)..... **$2.25**

445F. Plate, Revolving, Glass. Diameter 12 inches, center hole 1 1/8 inches (for use on Toepler-Holtz machine with 14-inch stationary plate) **$2.25**

450F. Plate, Revolving, Glass. Diameter 12 3/4 inches, center hole 1 1/8 inches (for use on Toepler-Holtz machine with 14 1/2-inch stationary plate) **$3.00**

460F. Plate, Stationary, Glass. Diameter 12 inches, center hole 2 inches (for use on Toepler-Holtz machine with 10 1/2-inch revolving plate) **$2.75**

465F. Plate, Stationary, Glass. Diameter 14 inches, center hole 2 1/2 inches (for use on Toepler-Holtz machine with 12-inch revolving plate) **$3.00**

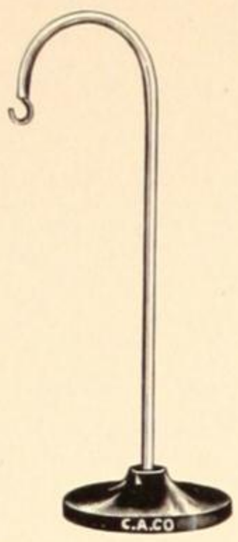
470F. Plate, Stationary, Glass. Diameter 14 1/2 inches, center hole 2 1/2 inches (for use on Toepler-Holtz machine with 12 3/4-inch revolving plate) **$3.75**

485F. Plate, Wimshurst, Glass. Diameter 8 in..... **2.50**
490F. Plate, Wimshurst, Glass. Diameter 10 in..... **3.00**
492F. Plate, Wimshurst, Glass. Diameter 12 in..... **3.50**
495F. Plate, Wimshurst, Glass. Diameter 14 in..... **4.00**
500F. Plate, Wimshurst, Glass. Diameter 18 in..... **8.00**

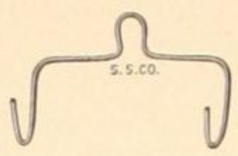
502F. Sectors, Wimshurst. Small size, for renewing or replacing the sectors on the plates of Nos. 362F and 364F Machines. Twelve in package..... **Per package $0.15**

503F. Sectors, Wimshurst. Large size, for renewing or replacing the sectors on the plates of No. 361F Machine. Twelve in package ..... **Per package $0.25**

504F. Supports, Grooved Hard Rubber. For supporting the Stationary Plate of No. 354F Toepler-Holtz Machine at two points at the bottom, and at one point at the top. Per set of three..... **$1.50**



No. 69B.



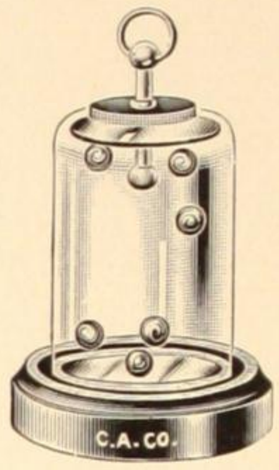
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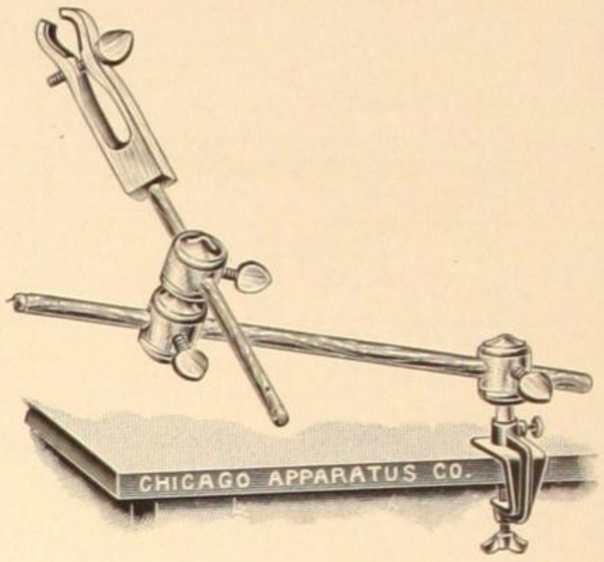
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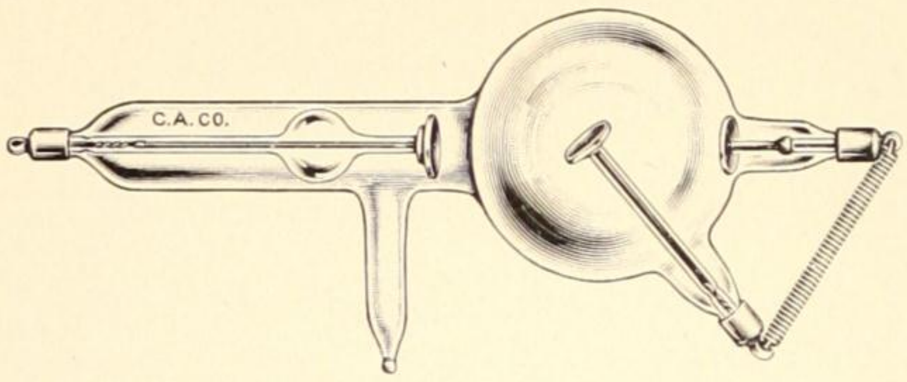
No. 515F.



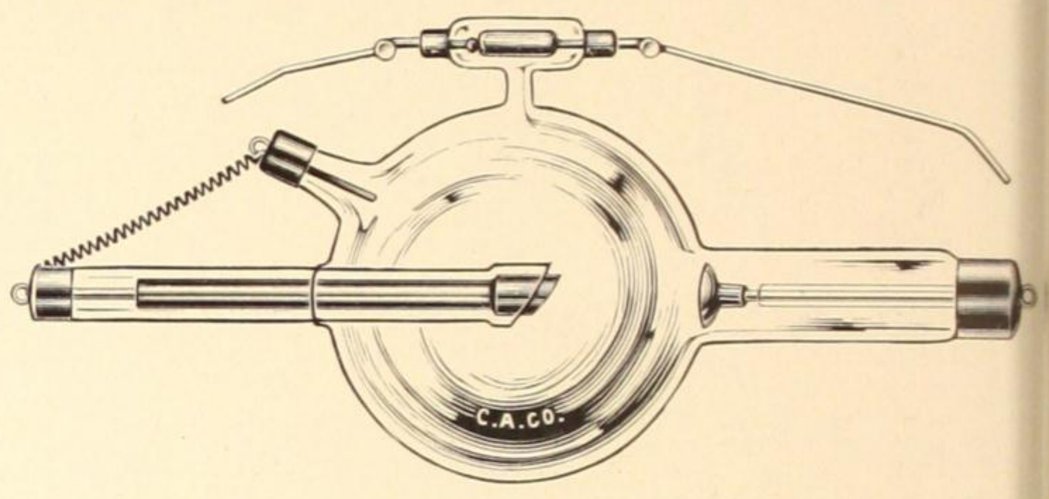
No. 520F.



No. 570F.



No. 541F.



No. 545F.

69B. Stirrup Stand. Japanned iron base, nickel-plated rod with hook; height, 37.5 cm. An excellent stand from which to suspend stirrups, pith balls, etc..**$1.50**

505F. Stirrup. For suspending electrified friction rods, bar magnets, etc. Made of heavy brass wire, with silk suspension; length, 12.5 cm.....**$0.15**

515F. Support, Universal. For holding all electrostatic accessories provided with a socket in the base. Saves the cost of a support for each extra accessory. Consists of an ebonite insulating rod mounted on a japanned iron base. Height, about 20 cm. Provided with a metal top which fits into socket in base of accessories, and hook for attaching chain from static machine **$1.00**

516F. Support Top. Metal disc, 15 cm. diameter designed to fit on top of No. 515F, making a convenient insulating stand **$0.90**

520F. Volta's Hail Storm. Consists of a wood base with a metal disc on its bottom, a 6x8.5 cm. glass shade with a metal disc inside near the top, and a number of pith balls. Designed to fit No. 515F Support. When connected to a static machine in operation, the balls bound back and forth between the metal discs **$2.50**

541F. X-Ray Tube, for Static Machines or Induction Coils. This tube is designed and constructed for use with static machines and induction coils producing a spark discharge 8 to 10 cm. long. It is especially suited to the needs of the average educational laboratory. It yields satisfactory results with No. 354F Toepler-Holtz Machine or No. 361F Wimshurst Machine, but the best results are obtainable with a No. 653E or No. 654E Induction Coil. The penetration of the X-rays produced by this tube are sufficient for viewing the bones of the hand and wrist, but not of thicker parts of the body. For observing the bony structure of the hands, coins in a purse, and other effects revealing the penetrating power of X-rays, requires the use of either No. 145F or No. 146F Fluoroscope. Diameter of tube, 8 cm. (3¼ inches) **$12.00**

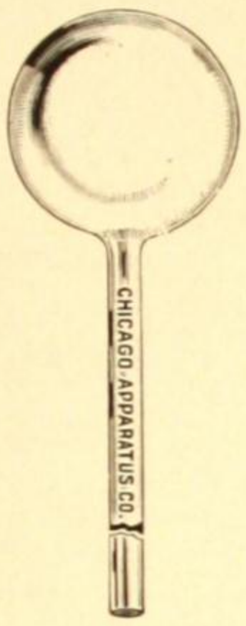
545F. X-Ray Tube, Tungsten Target Type, 6-inch Diameter. Especially pumped for use with our No. 654E or No. 656E X-Ray Coil. Remains cooler and maintains a more constant vacuum than tubes of smaller diameter. Also for these reasons it will not require vacuum reduction treatment as frequently as the smaller sizes. The chamber to which the long slender wire terminal is attached is filled with asbestos, treated with a chemical which vaporizes into a gas by the passage of a current. By adjusting the slender wire so that its terminal is within one inch of the cathode terminal and passing a spark for a second or two the internal resistance of the tube is lowered. This reducing treatment is only necessary when the vacuum in the tube becomes too high, as it will after considerable use. This heavy Tungsten target type tube is identically the same as that used in professional medical work where results and service are paramount to a small difference in cost.**$38.50**

570F. X-Ray Tube Support. Forms a rigid support when clamped to the edge of a table. Cannot topple over like the old style stand with base. Provides a very wide range of adjustment and for this reason the tube can always be arranged in the most convenient position. The large jaws are properly shaped and felt lined, hence will hold the tube securely and without the slightest danger of injury.

Black-glass enameled iron clamp with wooden rods and clamp provided with means for adjusting to any conceivable position.....**$6.00**

Apparatus for Heat

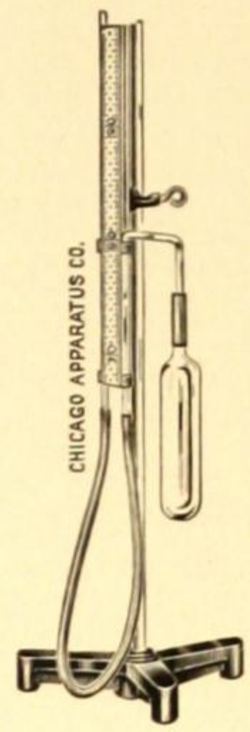
Section H



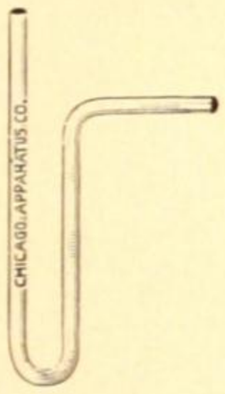
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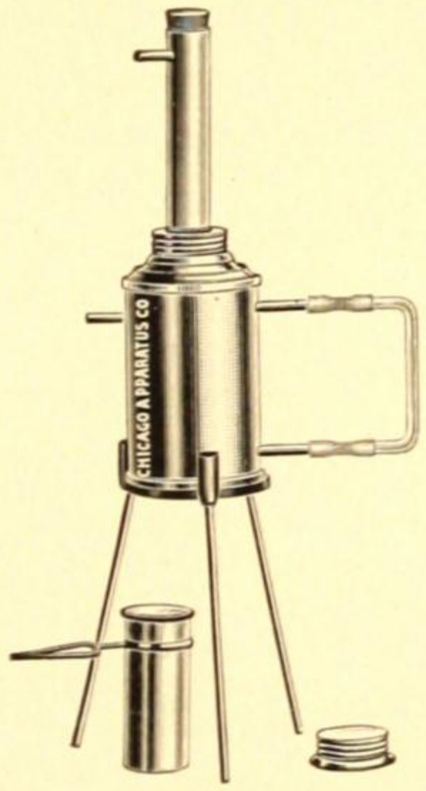
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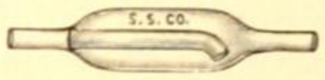
No. 21H.



No. 51H.



No. 36H.



No. 66H.

6H. Air Thermometer. Glass. Stem 30 cm. long, bulb 50 mm. diameter.....**$0.20**

11H. Air Thermometer. Glass. Stem 30 cm. long, bulb 25 mm. diameter.....**$0.20**

16H. Air Thermometer. Glass. Capillary stem 30 cm. long, bulb 50 mm. diameter.....**$0.35**

18H. Weight Thermometer. Ames and Bliss type. Bulb and tube about 15 cm. long, for temperature determinations by weight of mercury overflow method. Unfilled **$0.30**

21H. Air Thermometer. To show expansion of air or gas and to verify laws governing expansion. The scale to which the glass parts are attached is 30 cm. long, graduated in millimeters, and adjustably clamped upon an upright rod 60 cm. long with tripod base. The glass bulb has a capacity of about 175 cc. **$3.75**

26H. Air Thermometer. Same as No. 21H, but without tripod or support rod.....**$2.25**

31H. Air Thermometer Bulb. Glass bulb only of No. 21H. Capacity about 175 cc.....**$0.45**

36H. Apparatus "A." A simple form of steam generator for student use. Boiler of heavy polished copper, tinned inside, with water-tight seams, securely attached brass tubes, capacity, 1100 cc. Complete with thermometer tube, one-hole cork stopper to fit, copper dipper, screw cap, water gauge and separate iron tripod **$4.25**

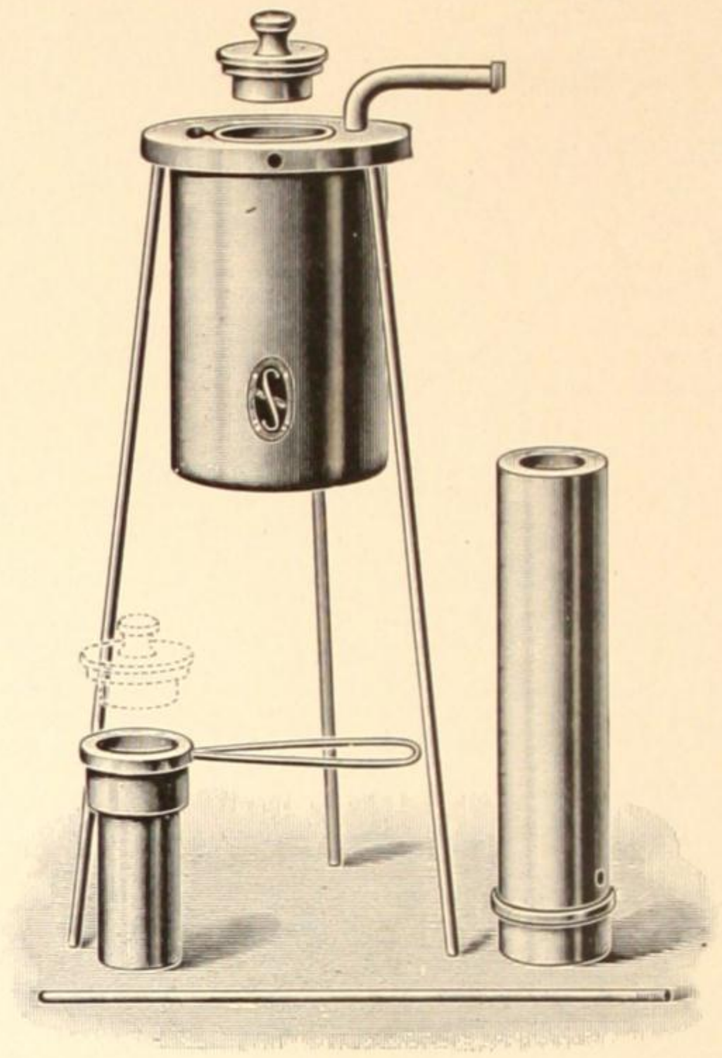
51H. Apparatus "A" Mercury Gauge. Glass manometer tube about 12 cm. long. To be used with No. 36H to indicate steam pressure. Without mercury **$0.25**

429R. Apparatus "A" Mercury Gauge. Glass manometer tube about 50 cm. long mounted on wood stand with scale graduated in millimeters.....**$3.00**

66H. Apparatus "A" Steam Trap. (Water Trap.) Glass, about 12.5 cm. long, for use with No. 36H. Curved inner tube prevents drops of condensed steam from passing through trap.....**$0.50**



No. 68H.



No. 70H.

68H. Steam Generator or Steam Bath. For use as a steam generator in the calibration of "mercury-in-glass" thermometers and as a steam bath for heating the bulbs of air thermometers (see Exp. 16, Mechanics, Molecular Physics and Heat, by Millikan). Consists of a large heavy copper boiler with double-walled steam jacket, mounted on a substantial iron tripod. The steam, after leaving the boiler, is forced to traverse to the top of the inner steam chamber and escape down through the outer chamber formed by the two walls, thus reducing radiation from the inner chamber to a minimum.

The cover of the steam jacket is removable. In the top is an opening fitted with rubber stopper for suspending "mercury-in-glass" thermometers. In the rim of the cover and the flange of the jacket are slotted openings for receiving the necks of air thermometer bulbs. When the cover is turned so that these holes are not superposed no steam can escape through them.

Dimensions of steam generator are: height, exclusive of stand, 45 cm., diameter at base 17 cm., outside diameter of steam jacket 10 cm., height of inner steam chamber 33 cm. by 7 cm. in diameter.

Complete, with water gauge and tripod, as illustrated **$15.00**

69H. Water Gauge Tube. Of glass, as used on No. 68H **$0.20**

70H. Hypsometer, Columbia University Design. The highest grade and most durable steam generator made. Used for years at Columbia University, the High Schools of Newark, N. J., and other well-known institutions where it has given the utmost satisfaction.

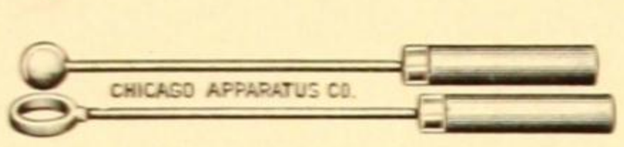
Has no soldered joints. Over a full flame, long after every drop of water has evaporated, this seamless boiler, spun from extra heavy copper, will not show the slightest sign of damage or injury. The boiler is secured steam-tight to a heavy brass ring, which is ⅞ inch thick at point of attachment and which thickness extends to the central opening. This thickness gives great depth to the central opening and provides long steam-tight joints when the cap, dipper or chimney are in place.

The protruding portion of the ring is ⅜ inch thick. Into it are screwed the three supporting legs and a right angled tube with hose-end for leading steam to linear expansion and other apparatus. When not so used this tube may be closed with the threaded end-cap furnished. The dipper fits snugly and steam-tight into the central boiler opening and is provided with a heavy metal long-seal cap.

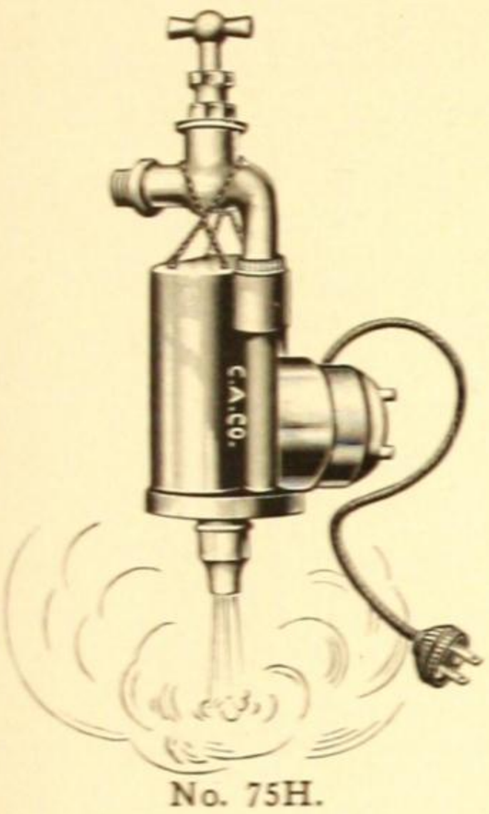
The thermometer tube also fits snugly and steam-tight into the central boiler opening. It is double-walled, live steam entering the top and escaping at the bottom. This protects the central area of the tube against radiation and insures correct thermometer indications.

For supporting this generator on a stand, a 15 cm. rod fitting into the threaded hole in the side of the top ring is furnished.

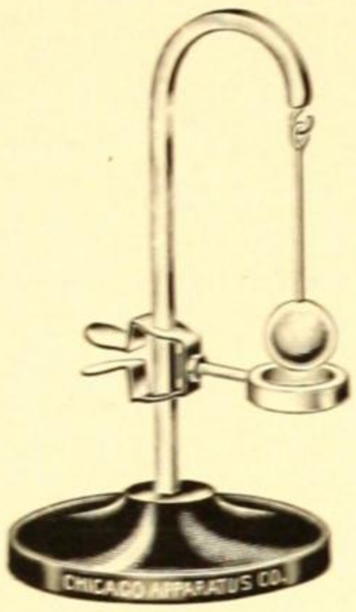
The entire apparatus is finished in nickel. Boiler capacity, 1000 cc.; overall height, on tripod, 58 cm. Complete as described and illustrated **$25.00**



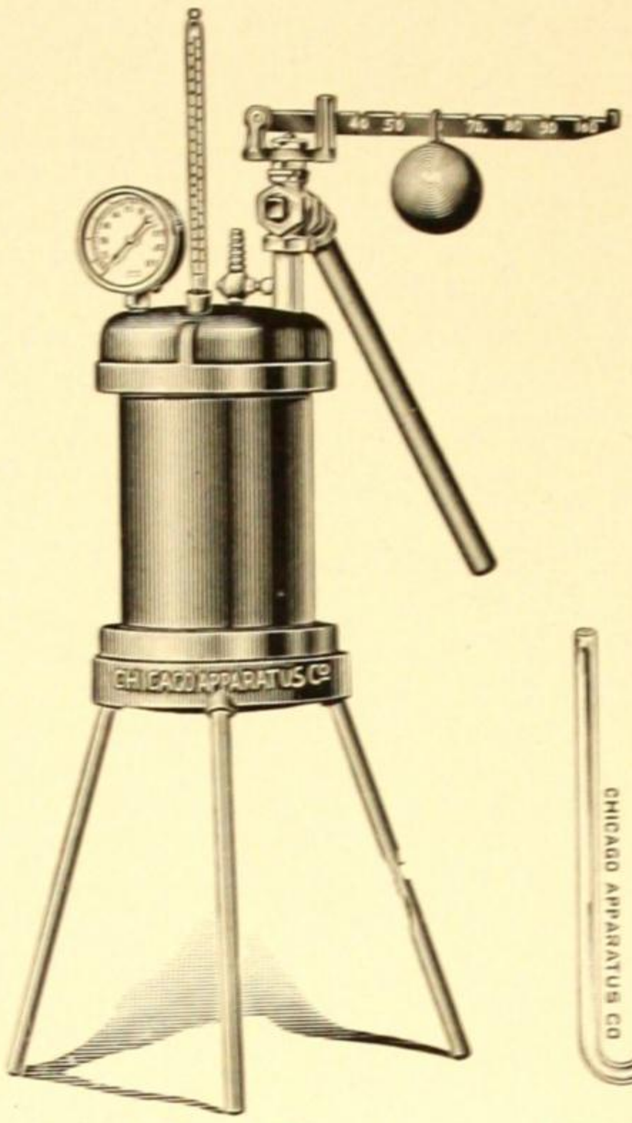
No. 81H.



No. 75H.



No. 82H.



No. 88H.



No. 610B.

No. 91H.



No. 93H.

75H. Hot Water Faucet Heater, Electric. Converts any cold-water faucet into an instantaneous hot-water source. In the laboratory such a source saves much time when used for filling steam generators, calorimeters, water baths, etc. Then too, it's a great convenience for washing beakers, flasks, funnels, jars, dishes, etc. It is very efficient. With cold-water at a temperature of 50° F it delivers 15 gallons per hours of warm water at a temperature of 85° F, 7.5 at 125°, 5 at 160°, or 3.75 gallons at 195° F; and smaller amounts at boiling, or 212° F. It fits either threaded or smooth faucets and is easily and quickly installed. Made entirely of metal, very rugged, and finished in highly polished nickel plate. Current consumption, 10 amperes. For use on either 110-volt A.C. or D.C. with cord and plug....**$15.00**

81H. Ball and Ring. For illustrating expansion of metal due to heat. Ball at ordinary tempeartures passes through ring, but when heated will not. Made of brass with hardwood handles.....**$1.20**

82H. Ball and Ring on Stand. Convenient lecture form for demonstrating the expansion of metal due to heat. Ball at room temperature readily passes through ring, but does not after having been heated. Ball is removable and provided with handle-form suspension link. The ring is provided with our quick-acting tension clamp so that it can be moved up or down instantly, yet held at any desired point **$3.50**

86H. Beads, Glass. For use in specific heat experiments .....**Per pound $2.00**

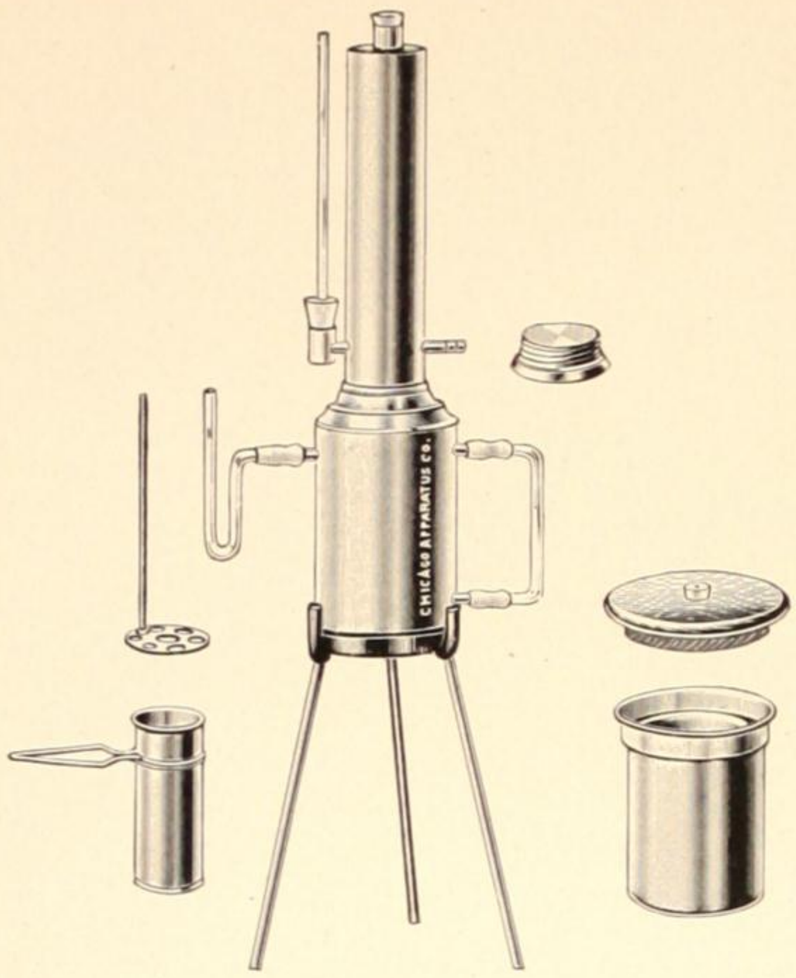
88H. Boiler, High Pressure, Milvay. Designed for making temperature determinations of steam for pressures up to 100 lbs. The sliding ball-weight may be set to release the steam at approximately 50, 60, 70, 80, 90 or 100 lbs. The steam gauge indicates the exact pressure within the boiler and has a range of 150 lbs. in 3-lb. divisions. By merely raising the valve arm the steam may be allowed to escape and the pressure lowered to any desired point. The thermometer socket extends far down into the boiler and is placed so all sides of it come into direct contact with the steam under pressure. This and the immersion of the thermometer bulb in oil (the size and depth of socket is ample for this purpose) insures correct temperature indications. Exhaust tube at rear may be adjusted to direct the escaping steam and water into a pail or other receptacle. Capacity of boiler, about 1000 cc. Overall height, on tripod, 60 cm. Absolutely safe; tested to withstand 300 lbs. pressure. Complete as illustrated, but without thermometer **$25.00**

610B. Boiler, Pressure, or Autoclave. Useful in the study of the effect of pressure on the boiling point. Made of polished, solid cast aluminum, brass fittings; steam gauge, reading 0 to 30 lbs.; pet-cock valve; automatic blow-off safety valve, adjustable to the desired pressure; socket for thermometer. Capacity 10 quarts; inside diameter, 9 inches; height, 8¼ inches. Without thermometer **$20.00**

91H. Boiling Point of Alcohol Tube. As used in Millikan, Gale and Bishop's Course. Glass U-tube with open arm about 20 cm. long and closed arm about 10 cm. long **$0.25**

93H. Bottles, Vacuum. For keeping hot liquids hot, and cold liquids cold. Can be taken apart to show construction. Cap is designed to serve also as a drinking cup.

	Pint	Quart
Each	**$1.50**	**$2.50**



No. 95H.



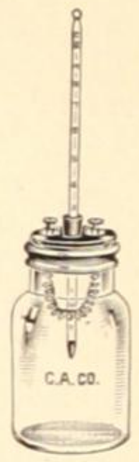
No. 96H.



No. 101H.



No. 123H.



No. 126H.



No. 131H.

95H. Calorimetric Outfit. Consists of copper boiler, double-walled steam jacket with pressure gauge and escape tube, dipper, screw cap and tripod. All parts are finished in finely polished nickel plate, except the tripod, which is finished with our non-clip, gloss-black enamel. The steam, as it leaves the boiler, traverses up through the central compartment to the top of the jacket, thence down the outer compartment formed by the double walls; the part not condensing escaping through the upright tube, and the condensed portion draining back into the boiler. Obviously, a thermometer suspended in the central compartment of the jacket is subjected to live steam only, eliminating errors due to radiation. The boiler has a capacity of 1100 cc. A double-walled aluminum calorimeter with fiber supporting ring for the inner vessel, wood cover, and stirrer complete the outfit. Capacities of the calorimeter vessels are: outer 1000 cc. and inner 300 cc.
Complete, as illustrated **$15.00**

96H. Calorimeter, Aluminum. Thin metal seamless form, finely polished. Better than the old brass form with soldered seams. Diameter, 7.5 cm.; height, 13 cm.; capacity about 600 cc..... **$0.50**

97H. Calorimeter, Aluminum. Same as No. 96H, but finished in dull black..... **$0.65**

101H. Calorimeter, Double Walled. Made of highly polished aluminum. Better than copper. Capacity of outer vessel about 1000 cc., of inner vessel about 300 cc. Inner vessel is supported and insulated from outer by fibre ring. Complete with wood cover and metal stirrer **$2.75**

106H. Calorimeter, Double Walled. Same as No. 101H, but without cover and stirrer..... **$2.25**

108H. Calorimeter Cup, Black Finish. Of aluminum, capacity about 300 cc. Fits either No. 101H or 106H Calorimeter and is useful in determining Newton's Laws of Cooling **$0.65**

111H. Calorimeter Cover. Of wood, with holes for thermometer and stirrer. Same as used in No. 101H **$0.30**

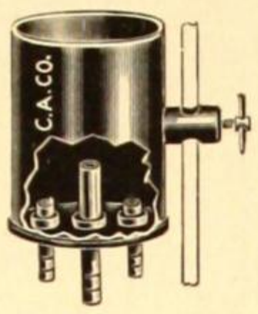
121H. Calorimeter Stirrer. Of metal, finished in white nickel-plate. Same as used in No. 101H. **$0.20**

123H. Heating Coil Attachment. Fountain's simple form. An open coil of chromel wire of about 4.5 ohms resistance, connected between two metal rods with binding-post terminals attached to a fiber top. The latter fits the inner vessel of either No. 101H or No. 106H Calorimeter and is provided with hole for thermometer. For use on 6-volt circuit..... **$1.50**

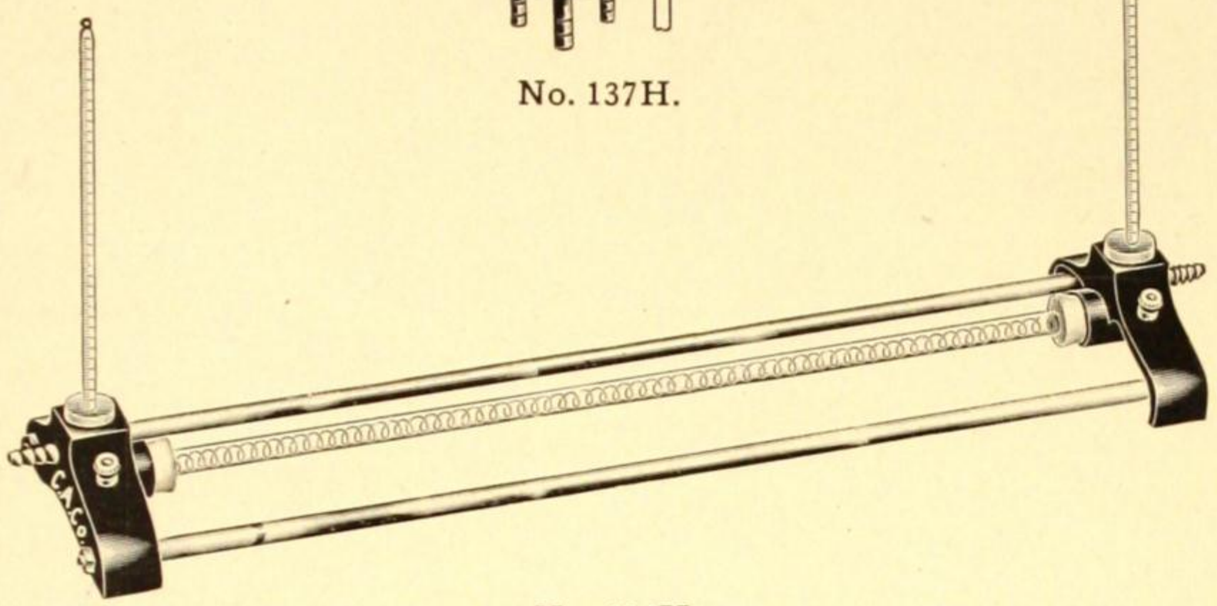
126H. Calorimeter, Electric. For showing the heating effect of the electric current and demonstrating Joule's Law. Glass jar with cover to which coil terminating in two binding posts is attached. Complete with thermometer..... **$3.50**

130H. Heating Coil Attachment. For verifying Joule's law of heating by an electric current. Consists of a fibre cover to fit Nos. 101H and 106H Calorimeters to which two brass rods with binding-post tops are attached. Between the lower ends of these rods is secured a chromel wire coil of 5 ohms resistance and wound on a heat-resisting material. The rods are protected by an insulating compound to prevent possible electrolysis effects. A special stirrer operable through the cover is included. The cover also has an opening for thermometer..... **$4.50**

131H. Calorimeter, Electric. After Millikan and Mills. Consists of No. 106H Calorimeter with No. 130H Heating Coil Attachment..... **$6.25**



No. 137H.



No. 136H.

136H. Calorimeter, Continuous Flow, Callender and Barnes. For determining the mechanical equivalent of heat (J) by means of the heating effect of an electric current. The end castings are of brass and are joined together by two 13 mm. insulated nickeled steel rods to form the base. Each end casting is fitted with two rubber stoppers—one pair holding the long Pyrex glass tube in which the resistance coil is enclosed; the other pair for holding the thermometers. Serrated hose nipples mounted in the end castings provide the inlet and outlet for the flowing water.

The resistance coil is of manganin wire designed to pass a current of about .6 ampere when connected into a 6-volt storage battery circuit. It may also be connected into a 110-volt D.C. circuit by introducing a rheostat to keep the current flow down to about .6 ampere.

The general procedure in using the apparatus is as follows: Connect it into a water supply line, through a constant water level tank, and adjust the flow until a gentle stream issues from the outlet side of the tank. After temperature equilibrium has been established, note the readings of the inlet and outlet thermometers. Next, connect the current source to the wire spiral with an ammeter in series and a voltmeter across its terminals. Adjust the current until the two thermometers indicate a difference of about 7.5° C. Record the readings of the thermometers, ammeter and voltmeter after the temperature indications of the thermometers have become constant. Collect and weigh about 500 cc. of water flowing from the calorimeter outlet tube and with a stopwatch, measure accurately in seconds the time required for its collection. Calculate the mechanical equivalent of heat (J) by substituting the above experimental data in the equation

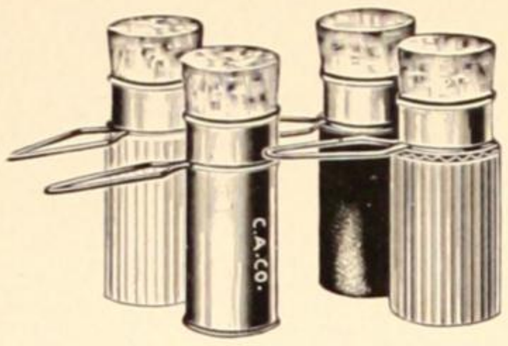
$$J = \frac{E\ I\ t}{m\ (t_2^0 - t_1^0)}$$

E = volts across terminals of wire spiral; I = current flow in amperes through wire spiral; t = time in seconds during which water was collected; M = weight in grams of water collected; t°2 = temperature rise in degrees C as noted on outlet thermometer; and t°1 = temperature rise in degrees C, as noted on inlet thermometer. By the method outlined above determinations for other values of current flow and other rates of water flow also may be made.

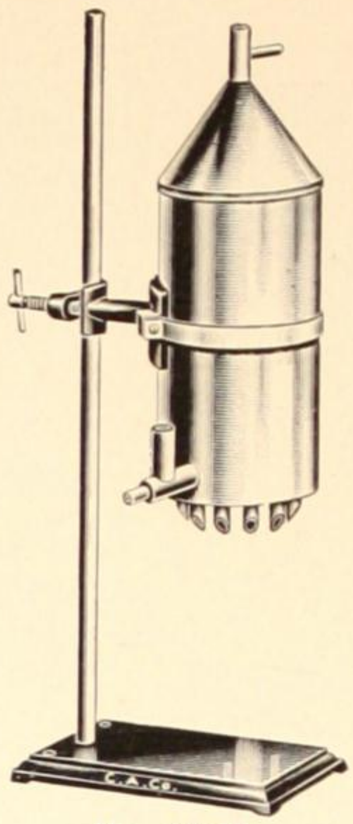
If desired, correction for cooling and radiation can be made by making two successive determinations, employing different rates of water flow with current flow adjusted to produce the same thermometer readings in each case. Since the rate of heat loss is the same in each instance, correction for this loss can be made. When this is done, results accurate to ¼% are possible with this instrument. Further, by assuming the value of J, the potential difference between two points on a conductor can be calculated and verified.

The overall length of the apparatus is 66 cm.; width 15.2 cm. As illustrated, but without thermometers or constant water level tank.....**$15.00**

137H. Constant Level Water Tank. Provided with inlet, outlet and center overflow tube, all corrugated for rubber tubing. Diameter 7.5 cm..; height 10 cm.; clamp fits a 13 mm. support rod. Made entirely of brass and finished in dull black. Designed for use in connection with No. 136H Continuous Flow Calorimeter **$4.50**



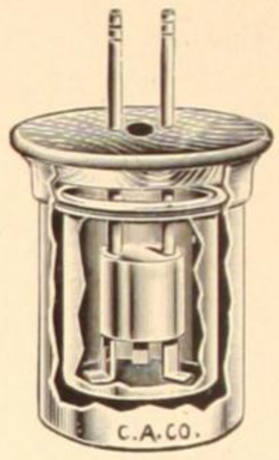
No. 138H.



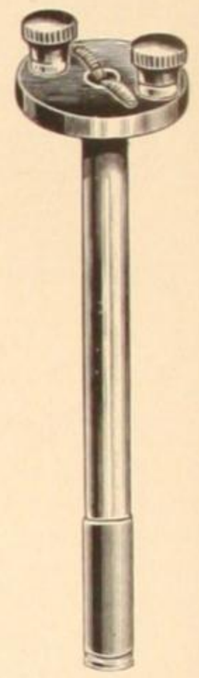
No. 141H.



No. 386H.



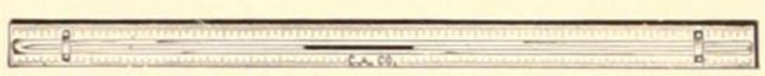
No. 145H.



No. 150H.



No. 161H.



No. 158H.



No. 166H.

138H. Dippers, Set of Four. For use in the study of the comparative efficiency of heat insulators as outlined in Exp. 30, "Laboratory Experiments in Practical Physics," by N. Henry Black and Exp. 71, "A Practical Physics Manual," by Ahrens, Harley and Burns. Consists of four dippers like those furnished in No. 36H Steam Generator Outfit, one plain, the other three having heat insulating jackets of different materials. All are provided with cork stoppers to prevent loss of heat by radiation. Per set of four **$4.50**

141H. Calorimeter, Junker's (Mann's Modification). For use in determining the amount of heat produced by the burning of a measured volume of gas, and for comparing the efficiency of various types of burners. Consists of a double walled copper vessel with a hollow central cavity, surrounded by twelve metal tubes or flues through the walls of which practically all of the heat produced by a burner flame is transferred, by conduction, to the water flowing through the calorimeter. From the initial temperature, final temperature and volume of water passed through the calorimeter the amount of heat, in calories, B.T.U. or other units, can be calculated. Either No. 386H Thorpe Gauge, No. 242H or No. 244H Gas Meter are convenient for measuring the volume of gas burned. The calorimeter is nickel-plated and highly polished to reduce radiation losses to a minimum. On support, as illustrated..... **$15.00**

386H. Thorp Gauge. For measuring approximately both the pressure and the rate of flow of gas. When the gas supply is attached to the inlet and the cap is screwed down over the outlet at the top, the pressure in inches of water is indicated on the left-hand scale. When the pressure cap is unscrewed and a burner screwed in its place, the number of cubic feet of gas consumed per hour is indicated on the right-hand scale **$17.50**

145H. Calorimeter, Latent Heat. For determining the latent heat of evaporation of water by the method described by Ames and Bliss. Consists of a double-walled aluminum calorimeter, fiber ring for supporting the inner vessel, cover for outer vessel, and metal condenser with inlets and outlets projecting through the cover as illustrated..... **$6.50**

150H. Immersion Heater for Specific Heat of Liquids Determinations. Same general construction as No. 252H, but with coil wound for operation on 6-volts. When this coil is immersed in equal weights of different liquids, contained in calorimeters or thermos bottles, and the temperature rise noted for like current input during like time intervals, the specific heat of the various liquids can be calculated and compared from the data thus secured. The coil is sealed water-tight in a thin copper shell at the extremity of a copper tube through which the terminals are brought up to binding posts mounted on an insulating disc at the top. Overall length, 28 cm.. **$6.00**

158H. Charles Law Tube. Waterman form. Consists of capillary tube over 40 cm. long, sealed at one end and containing a thread of dry air confined by a short mercury index, mounted on a wood back graduated in millimeters **$1.50**

161H. Compound Bar. For illustrating the unequal expansion of two dissimilar metals—brass and steel—due to heat. The two metals are fused, by welding, into an inseparable strip—10x½ inches—which is mounted in a wood handle. Gives better results and longer service than the old riveted type..... **$0.60**

165H. Conductivity Rods. Set of three. One each copper, glass and iron. Size, 12x⅛ inches. **Per set** **$0.30**

166H. Conductivity Rod. A short brass cylinder fastened between two long wood cylinders. When paper is wrapped about center of rod and held in flame, the part of paper around the wood burns, while that around the brass cylinder does not because the metal conducts the heat away so rapidly. Length about 25 cm. **$0.50**

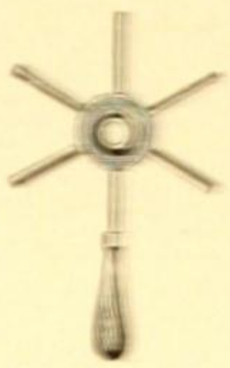
167H. Conductivity Rods. Set of five; one each aluminum, brass, copper, glass and steel. Size, 5x$\frac{3}{16}$ inches. **Per set** **$0.50**



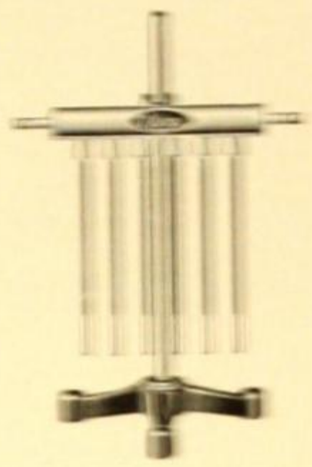
No. 168H.



No. 172H.



No. 176H.



No. 181H.



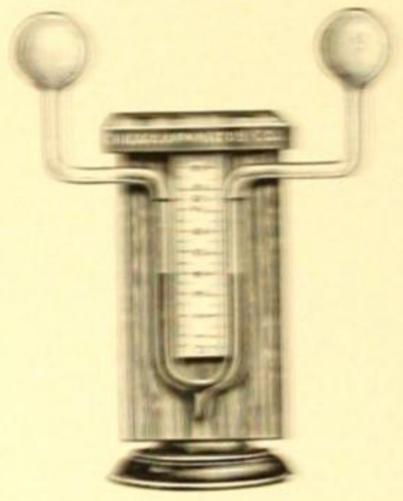
No. 193H.



No. 196H.



No. 211H.



No. 216H.

168H. **Conductivity of Water Apparatus.** Consists of an air thermometer sealed into the stem of a funnel as illustrated. For showing the non-conducting nature of water by the burning alcohol method. **$1.00**

172H. **Conductometer, Milvay.** For many years the wires in this popular conductometer have been mounted on a paddle-type handle. In our new model, illustrated above, they are mounted in a solid brass disk, which provides a better anchorage and permits heating without charring the handle. Also there is no obstruction between the disc and the ends of the wires to interfere with the conduction of the heat. The conducting wires are of copper, iron, aluminum and brass, each 15 cm. long, and mounted in a solid brass block 16 mm. in diameter; to which the wooden handle is attached. In use, this new conductometer may be held in the hand, clamped to a support, or laid upon a ring. **$0.75**

176H. **Conductometer.** Brass cone with six rods of different metals attached. One rod is provided with a hardwood handle. Each of the rods—at points equally distant from the center—has a cavity for phosphorous **$1.25**

181H. **Conductometer, Milvay.** Consists of a metal tube from which rods of six different metals project downward. The rods are 20 cm. long and are coated with a special paint, with the exception of a short distance at the lower end, where the material is exposed to view. When steam is passed through the metal tube the progress of the heat conduction is shown in a very striking manner by a change of color which the paint undergoes when heated. Complete with support, as illustrated. **$6.50**

193H. **Convection Gas Apparatus.** Convection currents—set up by placing a candle under one of the chimneys—may be clearly demonstrated by holding a piece of No. 391H Touch Paper over the top of the other chimney. Metal box 23x10x10 cm. with glass front and two glass chimneys. **$2.50**

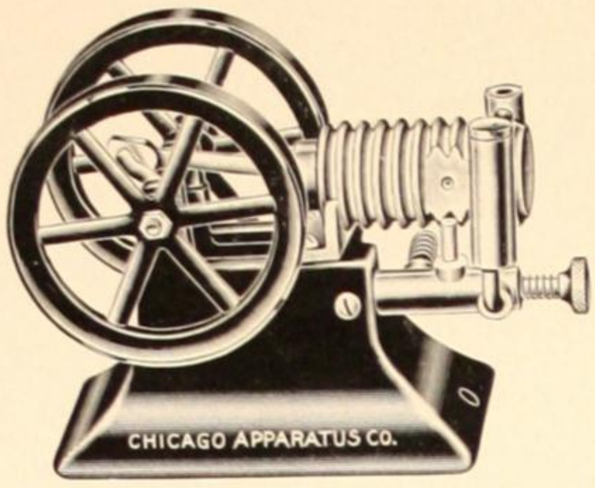
196H. **Convection Apparatus.** Liquids. A glass tube of rectangular shape, about 15x20 cm., with opening at top for introducing water. By adding a little aniline dye, the convection currents set up in the water, when the lower part of the rectangle is heated, can be plainly seen **$1.60**

201H. **Cooling Tube, Acetamide.** A test tube containing sufficient acetamide for performing the experiment on cooling through change of state. **$0.35**

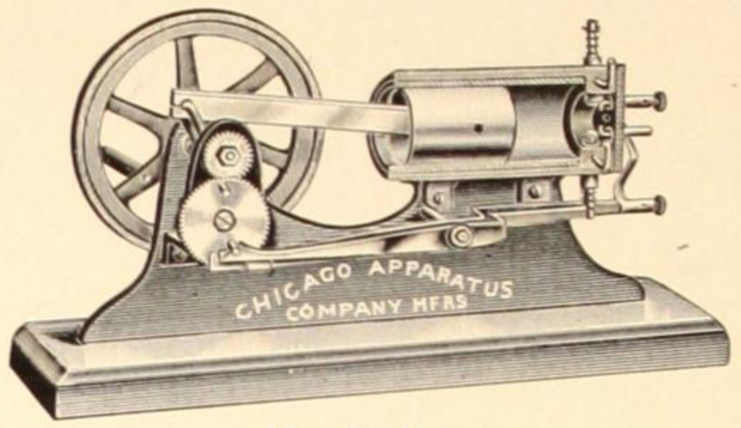
206H. **Cooling Tube, Naphthaline.** A test tube containing sufficient naphthaline for performing the experiment on cooling through change of state. **$0.25**

211H. **Cryophorus.** For showing the decrease in temperature of water through rapid evaporation. A glass tube, about 50 cm. long with bulb on each end, containing water and water vapor. Placing the lower bulb in a freezing mixture condenses the water vapor, reducing the pressure within the tube. The water in the upper bulb, owing to the decreased pressure, evaporates so rapidly that it freezes. **$1.50**

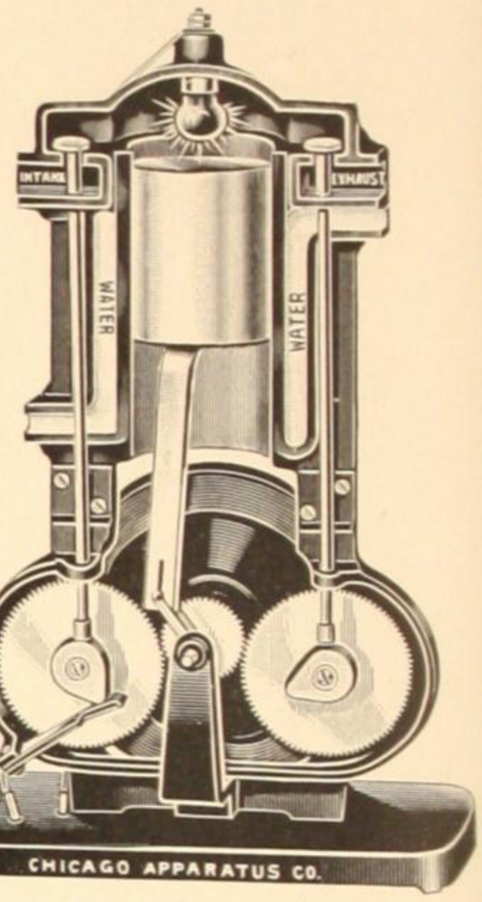
216H. **Differential Thermometer.** For showing differences of temperature between two neighboring positions. This form is provided with a platform so that a Leslie's cube (4"x4"x4") may be placed between the bulbs for illustrating the rates at which the different surfaces of a body radiate heat. May also be used in all experiments where Leslie's thermometers are used. Overall height, 28 cm. **$3.50**



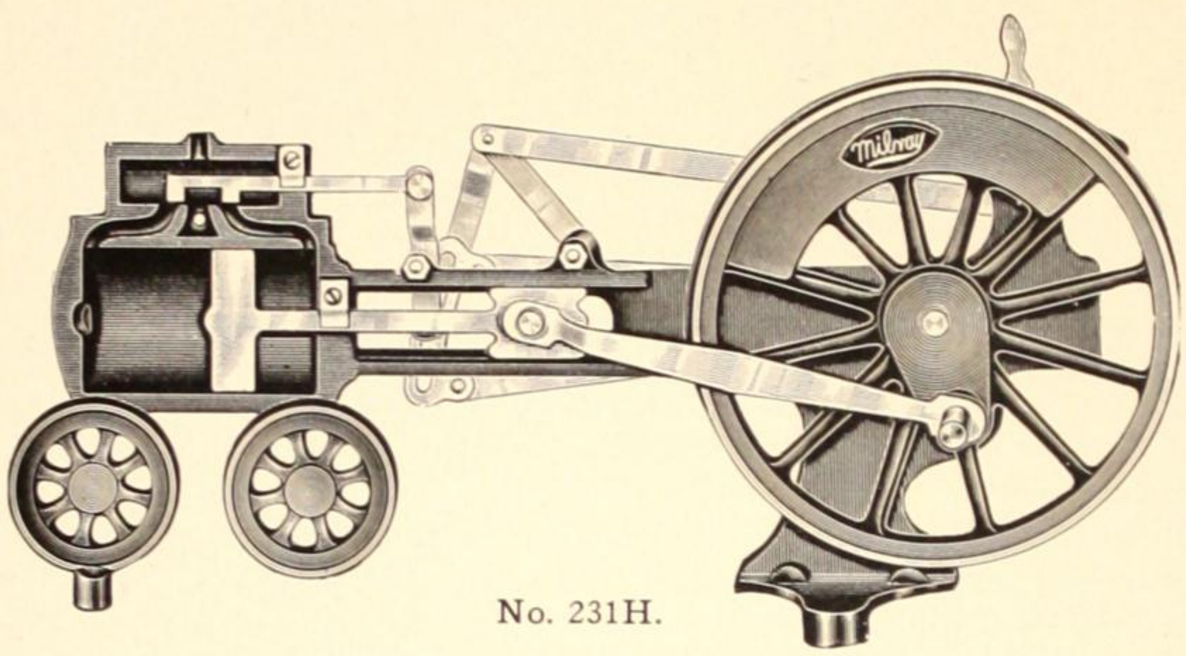
No. 218H.



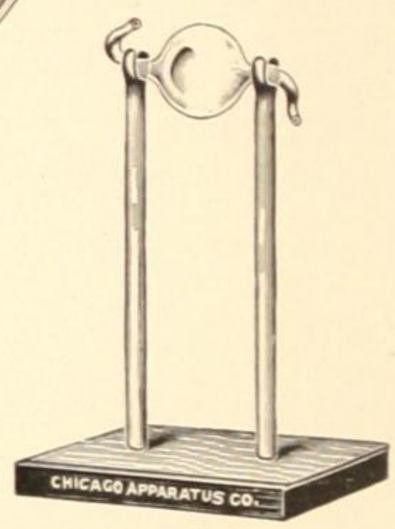
No. 221H.



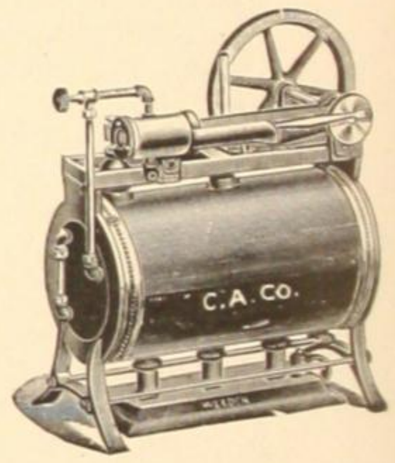
No. 226H.



No. 231H.



No. 228H.



No. 232H.

218H. Engine, Gas, Working Model. Operates only on gas manufactured from coal (artificial gas). Size of base, 8x15 cm. **$8.50**

221H. Engine Model, Gas. A true reproduction, in section, of the modern gas engine. All parts—inlet valve, exhaust valve, piston, spark plug, connections, shafts, etc.—are adjusted to their proper position. Intake, compression, explosion and exhaust strokes are easily demonstrated. If the secondary of an induction coil is connected in series with the spark plug, the spark may be shown at the proper time. On hardwood base, 10x30 cm. **$14.50**

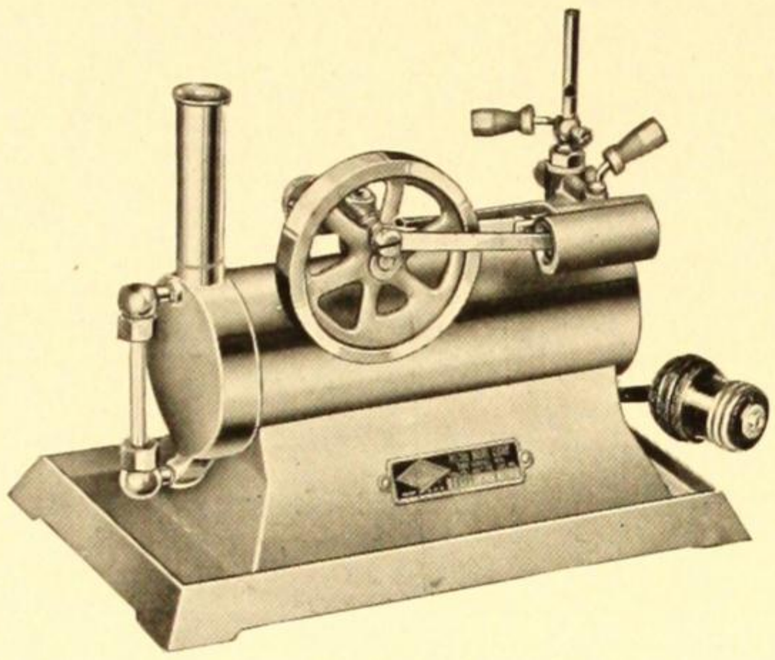
226H. Engine Model, Gas, Milvay. Large size, 37.5 cm. high. Can be seen by every student in a large class. The spark plug is represented by a small incandescent bulb, colored red, which flashes at the beginning of each explosion stroke, thus producing a most realistic effect. One dry cell operates the lamp, thus doing away with the induction coil used in older models. The Milvay is a model of the vertical four-cycle type of gas engine—the type that is used in automobiles, motor trucks, aeroplanes, motor boats, motorcycles, etc. The four cycles—intake stroke, compression stroke, explosion stroke and exhaust stroke—are made perfectly clear with the Milvay. All parts are adjusted to their proper position and shown to the best advantage. It illustrates valve action, cam action and timing gear action. It also shows the following parts in their true relationship: Cylinder, piston rod, crank shaft, valves, valve stems, gas intake port, exhaust port, water jacket, valve lifting cams, crank case, spark plugs (incandescent lamp) and fly-wheel. It is much larger and superior to the horizontal gas engines on the market. The Milvay is used in such well known institutions as Tulane University, New Orleans, La.; Ohio University, Athens, Ohio; Lane Technical High School, Chicago, Ill., etc. Made entirely of metal, substantially constructed and handsomely finished.... **$25.00**

228H. Engine, Hero's (Steam Reaction Wheel or Rotating Ball). For exhibiting the reaction set up by steam escaping from lateral jets. The ball, 50 mm. in diameter, and made of Pyrex heat-resisting glass, will rotate rapidly in its mount when partially filled with water and heated in a Bunsen burner or alcohol lamp flame until steam issues from the jets. Mounted on 10x15 cm. hardwood base. Overall height, 28 cm. **$3.50**

231H. Engine Model, Steam, Milvay. Large size, 18 cm. high, 38 cm. long. Made entirely of metal. Each part is accurately formed and adjusted. Complete model of locomotive engine, showing a section through the steam chest with piston and valve connected to their proper parts. Clearly illustrates link motion, use of reversing gear, and action of eccentric **$6.50**

232H. Engine, Steam, Working Model. Horizontal type with boiler. Shows all essential parts and is well built. Overall height, 9¾ inches; overall length, 9½ inches; weight, about 5 lbs. Complete with 3-tube alcohol lamp..... **$7.50**

New Engine Models—Electrically Heated



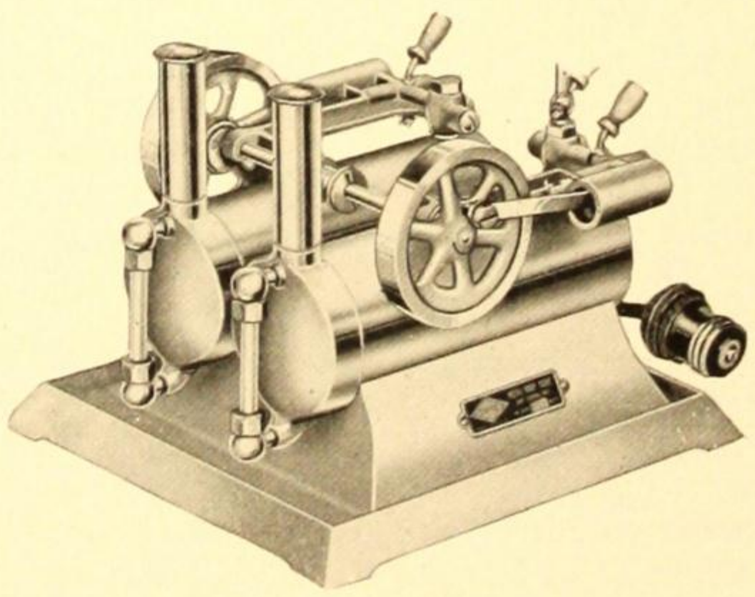
No. 234H.

These modern working models will appeal to teachers who appreciate devices that permit of more effective demonstrations, that are safer and more convenient to use, that are more efficient, that are more durable, that are finer in workmanship, and that are more pleasing in appearance; for such devices are always far more attention compelling. Then, too, these new electrically heated engines always stay bright and clean. There is no smudge formation and no fuel to spill as in the older crude, inefficient, flame-heated models. They operate direct from any 110-volt A.C. or D.C. standard light socket. The series includes a single cylinder reciprocating type steam engine, a double cylinder reciprocating type steam engine, a turbine type steam engine, and a hot air engine described in detail below.

234H. **Steam Engine, Single Cylinder Type, Electrically Heated.** Seamless drawn copper boiler, heavy cast base, accurately machined brass running parts with steel connections. Base, steam chest, and fly-wheel spokes finished in bright red enamel; other parts, nickel plated. The gauge glass, held in threaded packing nuts, is readily replaceable in case of breakage. A safety blow-off valve permits steam to escape through stack when pressure becomes excessive. The well-balanced fly-wheel provides smooth, vibrationless action. A small pulley attached to the shaft enables the operation of small devices. A cord or rubber band may be used as a belt for transmitting the power. Operates for about 45 minutes on one filling. A hand-controlled whistle provides a simple means for testing the steam pressure and illustrating the principle of the steam whistle. A hand-controlled throttle regulates speed. Small current consumption, 300 watts. Size, 9¼x5¾x7½ inches. Weight, 6¾ lbs. Operates on 110 volts A.C. or D.C.

Complete, with five-foot connecting cord and full operating directions **$12.00**

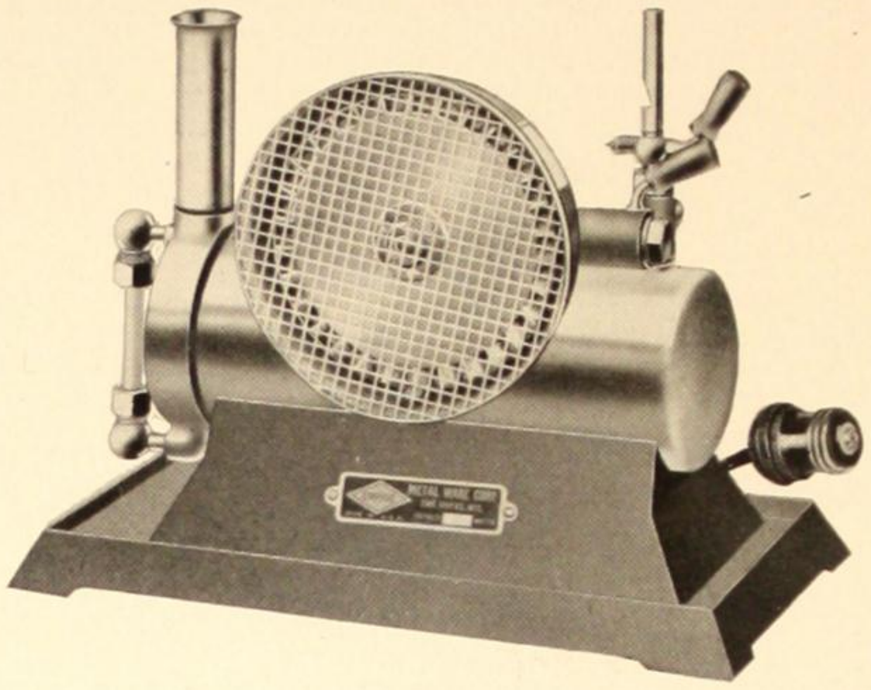
235H. **Steam Engine, Double Cylinder Type, Electrically Heated.** Equivalent to two No. 234H engines mounted on a common base with double the heating capacity and double the power. Has two cylinders, separate throttles, two fly-wheels, water-gauges, stacks, safety valves and one whistle. A powerful engine that will operate larger devices than the single cylinder type. Current consumption, 600 watts. Size, 9¼x8½x7½ inches. Weight, 12¼ lbs. Operates on 110 volts A.C. or D.C.



No. 235H.

Complete, with five-foot connecting cord and full directions **$25.00**

New Engine Models—Electrically Heated—Cont.



No. 236H.

236H. Steam Engine, Turbine Type, Electrically Heated. This engine follows the latest development in steam power plants. It is a miniature duplicate of large single-phase steam turbines, and develops a fascinating natural turbine hum. Unexcelled for speed. Similar to No. 234H steam engine with the exception of generating mechanism. Equipped with hand-operated throttle for regulating speed, whistle for testing steam pressure, safety blow-off valve, water gauge, seamless drawn copper boiler, heavy cast base and accurately machined brass running parts with steel connections. Base, generating mechanism, throttle handle, and whistle handle finished in bright red enamel; other parts, nickel plated. Current consumption, 400 watts. Size, 9¼x5¾x7¼ inches. Weight, 6½ lbs. Operates on 110 volts A.C. or D.C.

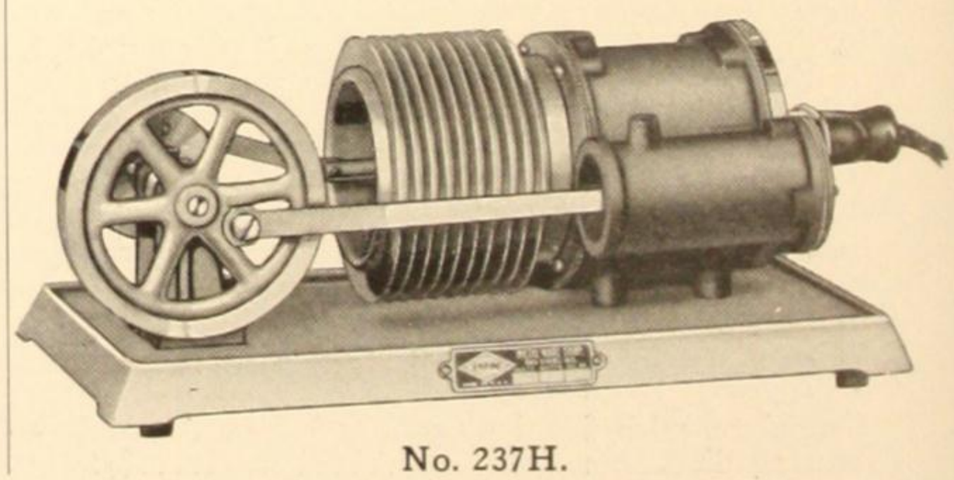
Complete, with five-foot connecting cord and full directions **$10.00**

Operating Directions for Models Nos. 234H, 235H, and 236H.

Unscrew stack and fill boiler three-fourths full of water, as indicated by the gauge glass. Replace stack and make connection to a 110-volt (either A.C. or D.C.) lamp socket. After the lapse of five minutes, and occasionally thereafter, test the steam pressure by moving the handle of the steam whistle. When maximum pressure has been developed, as indicated by the escape of steam through the blow-off valve in the stack, open the throttle and give the fly-wheel a slight turn to start it going. Vary the speed by moving the throttle handle, which regulates the flow of steam into the steam chest or turbine generating mechanism. Oil the moving parts before using and empty the boiler after using to insure the best results and longest period of satisfactory service.

237H. Hot Air Engine, Electrically Heated. An interesting application of the expansion of gases (in this case air). A loose-fitting plunger shifts the air back and forth in the large cylinder, which is heated at one end and cooled by radiating fins at the other. An opening, or passage, near the closed end of the small or working cylinder, communicates with the heated end of the large cylinder. When the large piston moves down, the hot air below is transferred to the top, where it is cooled and thereby made to contract. The small piston is then forced down by the external pressure of the atmosphere. As soon as this small piston is near the bottom of its stroke the large piston is raised, causing the air to flow back under this large piston, where it is again heated. This makes it expand, forcing the small piston up again, and then the cycle is repeated. This new model develops unusual power and will run for hours without attention, only an occasional oiling. Assembled on heavy cast base. Has accurately machined brass running parts with steel connections. Base and fly-wheel spokes finished in bright red enamel; other parts nickel-plated. Current consumption, 350 watts. Size, 12x6x5¾ inches. Weight, 11 lbs. Operates on 110-volts A.C. or D.C. Starts instantly—no delay.

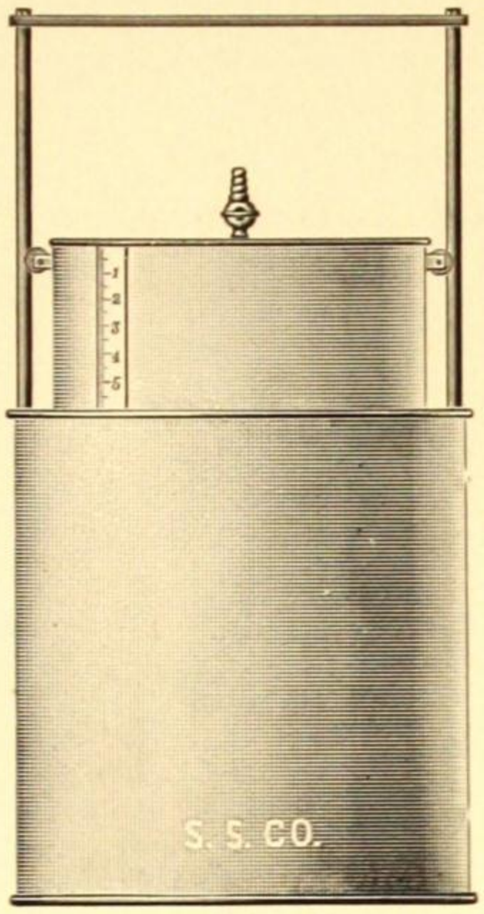
Complete, with five-foot connecting cord and directions **$15.00**



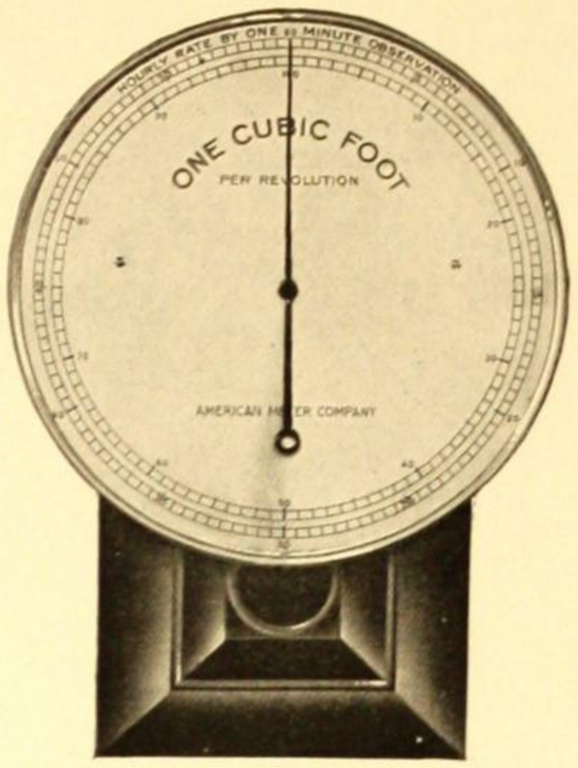
No. 237H.



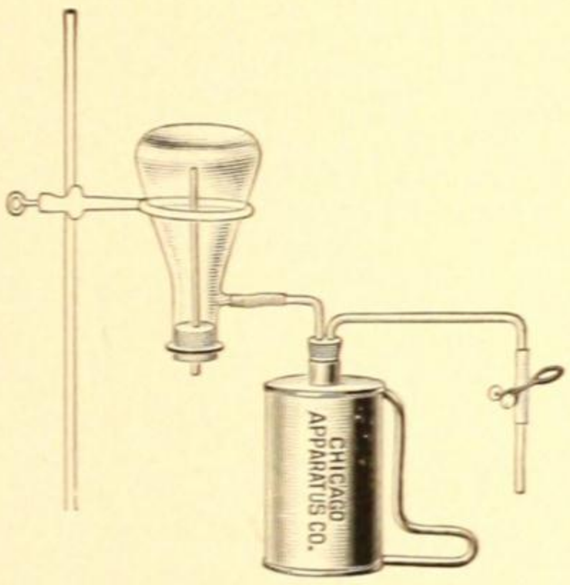
No. 241H.



No. 242H.



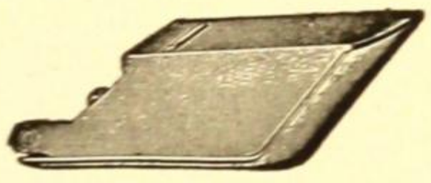
No. 244H.



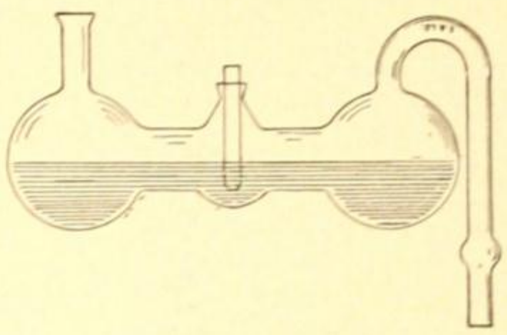
No. 243H (in use).



No. 247H.



No. 248H.



No. 249H.



No. 251H.

241H. Fire Syringe. For illustrating generation of heat due to air compression. Brass cylinder—34 cm. by 15 mm.—on iron stirrup, piston and piece of tinder **$4.00**

242H. Gas Meter, Constant Pressure. Millikan, Gale and Bishop's form. Made entirely of metal, with guides, stop cock and scale reading to 1-100 cu. ft. Capacity 1 cubic foot. Height about 75 cm... **$30.00**

244H. Gas Meter, Commercial Form. Standard two-diaphragm type with large hand for easy reading. For testing gas consumption of one to five lights at a time. Indicates hourly consumption rate by one-minute observation, eliminating all calculation. Dial 38 cm. in diameter..... **$50.00**

602K. Heat Shield. Of wood. Useful in shielding calorimeters and other apparatus from the heat radiated by steam generators. Consists of a vertical board 30x15 cm., having an opening at its center for the passage of the delivery tube from the steam generator. Mounted on the edge of a large wooden base **$1.25**

243H. Hot Water Tank Model, Dull's. For studying convection currents in a hot water tank as described in "Laboratory Exercises in Physics," by Charles E. Dull. Consists of a 1000 cc. heavy copper tank with curved coppered tube attached to its side. Complete with bent and straight glass tubes, 500 cc. side neck flask, rubber stoppers and pinchcock, but without stand **$6.00**

246H. Ice Bag. For breaking ice. Heavy canvas, 20x35 cm. **$0.25**

247H. Ice Bomb. For illustrating the expansive power of freezing water. Filled with water and placed in a freezing mixture causes the bomb to burst. Made of iron, about 7 cm. long, with tight-fitting screw plug in each end **$0.40**

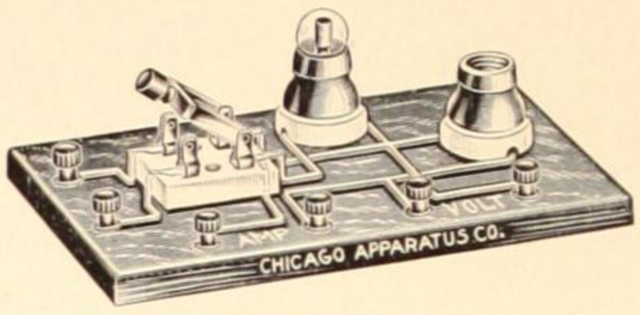
248H. Ice Shaver. For producing either coarse or fine shavings; of tinned iron with removable steel cutter **$0.75**

249H. Ice Machine. Glass, after Carre..... **4.50**

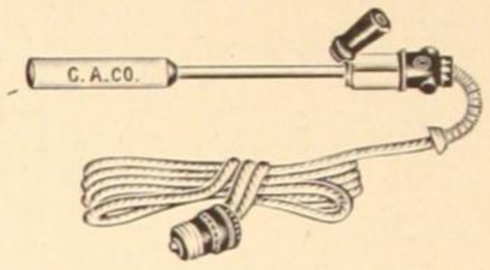
251H. Ice Tray. Galvanized iron, 37.5x5x5 cm., with tubulature at one end. For cooling the air column in Volume Coefficient Tubes, Nos. 406H and 411H **$0.75**



No. 252H.



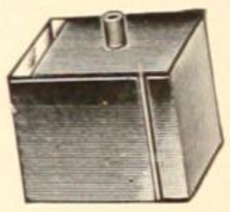
No. 253H.



No. 255H.



No. 256H.



No. 261H.

252H. Immersion or Cup Heater, Milvay. A specially designed unit for use in the determination of the mechanical equivalent of heat by the electrical method as outlined in Exp. 23, "General Physics for the Laboratory," by Taylor, Watson and Howe. The heating element is mounted in a thin brass shell 2 inches long, and its terminals are brought up through a copper tube to binding posts at the top. The construction is leak-proof and designed to insure the rapid and maximum transfer of heat to the water in which it is immersed. Current consumption 75 Watts. For use directly on 110 volt circuits. Overall length, 20 cm..... **$7.50**

253H. Pilot Light Connection Board. For connecting No. 252H Immersion Cup Heater and measuring instruments into circuit, so that the ammeter indicates only the current flow through the heater, and the voltmeter only the potential across its terminals. The switch provides a close-by means for turning the current on and off. Also, its convenience makes for greater accuracy in timing the current flow. The neon pilot light reveals instantly any failure or interruption of the current flow, which might falsify the final result. It is so placed in the circuit that the current flowing through it, though very small, does not pass through the ammeter. The socket at the right is for attaching the plug of the heater cord. On finely finished hardwood 30x17.5 base. Complete with 110 volt A.C. neon pilot light..... **$10.00**

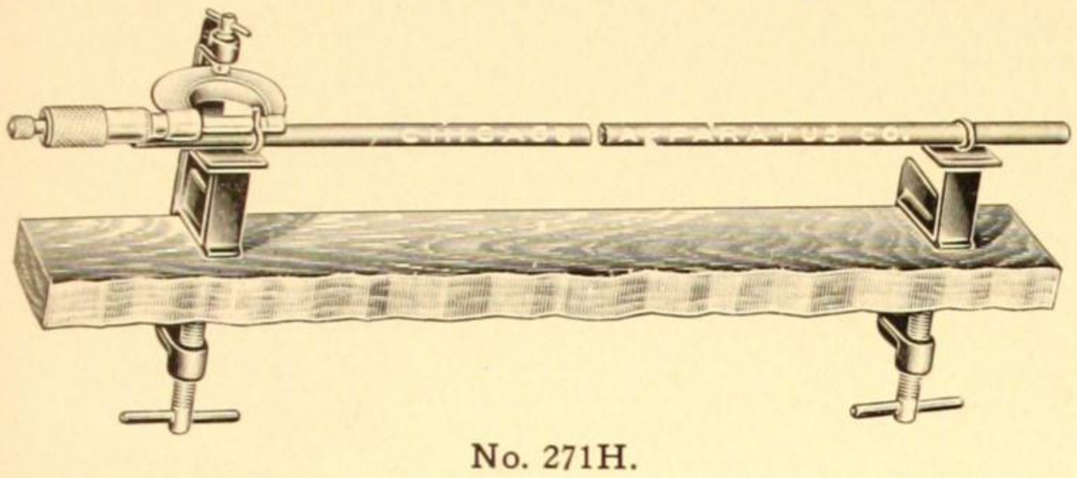
255H. Immersion Heater, Electric, Cylindrical Form. Convenient for quickly heating or boiling liquids to be used in lecture work. Also suitable for laboratory use in power cost, operating efficiency, and heat per Watt experiments. Size of heater section, 7x¾ inches. Current consumption, 300 Watt. Of copper and brass, heavily nickel-plated and polished. With cord attachment plug and special contact plug. Operates direct on either A.C. or D.C. circuits.

No.	A	B
For volts	110	220
Each	**$4.85**	**4.85**

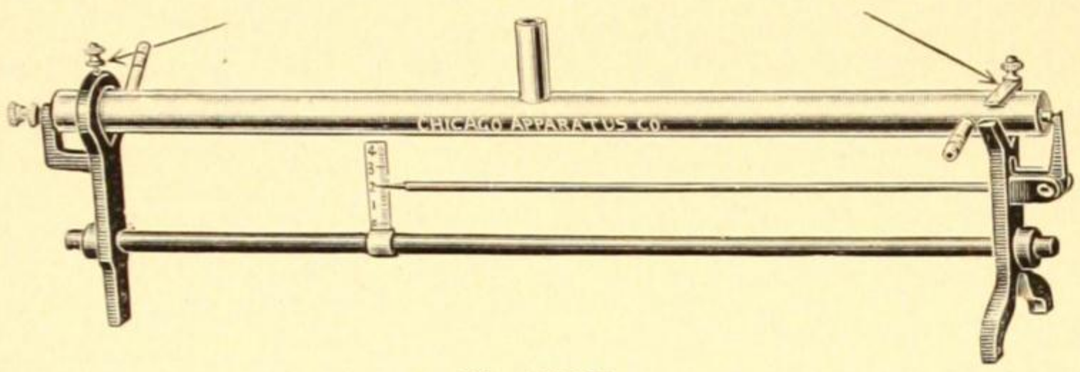
256H. Lead Cylinder. As used in Fuller and Brownlee's Course. Weight, 600 to 700 grams; with hook. For use in specific heat experiments..... **$0.60**

261H. Leslie's Cube. For illustrating laws of radiation. Hollow metal cube—7.5x7.5x7.5 cm.—with each of its four sides of a different metal, finely polished. Complete with one-hole rubber stopper for thermometer **$3.50**

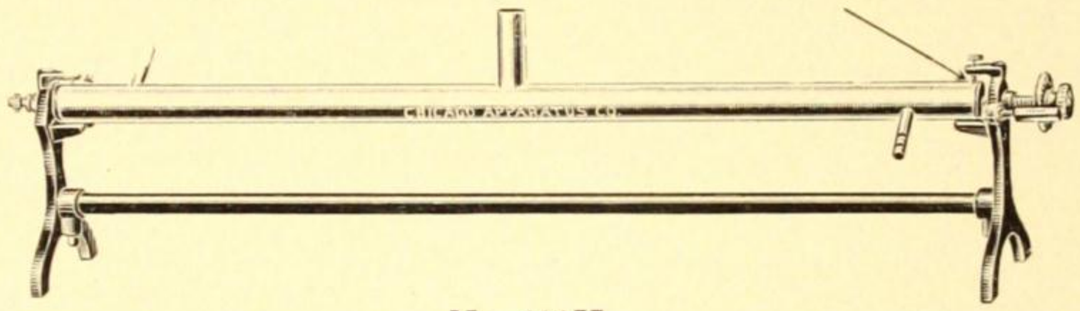
Linear Expansion Apparatus



No. 271H.



No. 276H.



No. 281H.

271H. Linear Expansion Apparatus. Carhart and Chute's Form. Consists of a brass expansion tube 100 centimeters long and two special table clamps for supporting same. One clamp is provided with a screw by means of which a micrometer caliper may be used as a measuring device. The tube is provided with two lugs whose distance apart may be measured. One lug holds the tube in a fixed position, the other makes contact with the movable jaw of the caliper for measurement of the expansion. Complete as illustrated, but without micrometer caliper **$2.25**

253M. Micrometer Caliper. For use with No. 271H Expansion Apparatus. Reads up to 13 millimeters in 1/100 mm. divisions. Provided with friction stop **$4.25**

276H. Linear Expansion Apparatus, Lever Type. Milvay Improved Form with Jacket Clamped at Both Ends. Offers many advantages over older models with neither or only one end clamped. Apparatus is easier to handle, carry and store because jacket cannot fall off. The thermometer used in the experiment is safe because jacket cannot revolve. The test rod cannot shift from accident or otherwise. It takes only a moment to change test rods—a turn of the clamping screws releasing the jacket. The lever—ratio 10 to 1—is extra strong. The pointer cannot be bent, twisted or broken like the thin sheet aluminum pointer used on older models. Made entirely of metal. Nickel-plated brass steam jacket with inlet and outlet tubes for steam and special tube for thermometer. Complete with 60 cm. steel test rod.. **$5.00**

281H. Linear Expansion Apparatus, Micrometer Type. Milvay Improved Form with Jacket Clamped at Both Ends. Offers many advantages over older models with one or neither end clamped. Apparatus is easier to handle, carry and store because jacket cannot fall off. The thermometer used in the experiment is safe because jacket cannot revolve.

The test rod cannot shift from accident or otherwise. It takes only a moment to change test rods—a turn of the clamping screws releasing the jacket. Made entirely of metal. Nickel-plated brass jacket with inlet and outlet tubes for steam and special tube for thermometer. Micrometer screw reads to .01 mm. Binding posts, carefully insulated, are provided so that a bell or buzzer may be used to announce screw contact with test rod.

Complete with 60 cm. steel test rod..... **$8.00**

Extra Rods for Nos. 276H and 281H

286H. Aluminum Rod, 60 cm. long..... **$0.25**

287H. Brass Rod, 60 cm. long..... **.25**

288H. Copper Rod, 60 cm. long..... **.30**

289H. Iron Rod, 60 cm. long..... **.20**

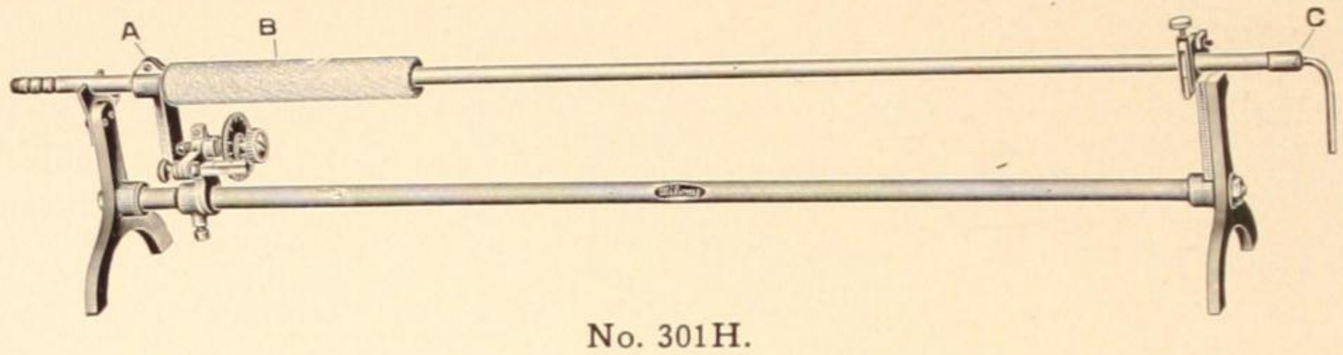
290H. Nickel Alloy, 60 cm. long. Coefficient of expansion practically nil..... **$0.85**

291H. Nickel Silver, 60 cm. long. (German Silver) **.75**

296H. Linear Expansion Apparatus. Millikan, Gale and Bishop's Form. Notched brass tube, 8 mm. diameter, 107 cm. long, and metal pointer. For use with No. 385S Wood Blocks and No. 395S Graduated Mirror **$1.50**

297H. Brass Tube only of No. 296H..... **.70**

298H. Metal Pointer only of No. 296H..... **.80**

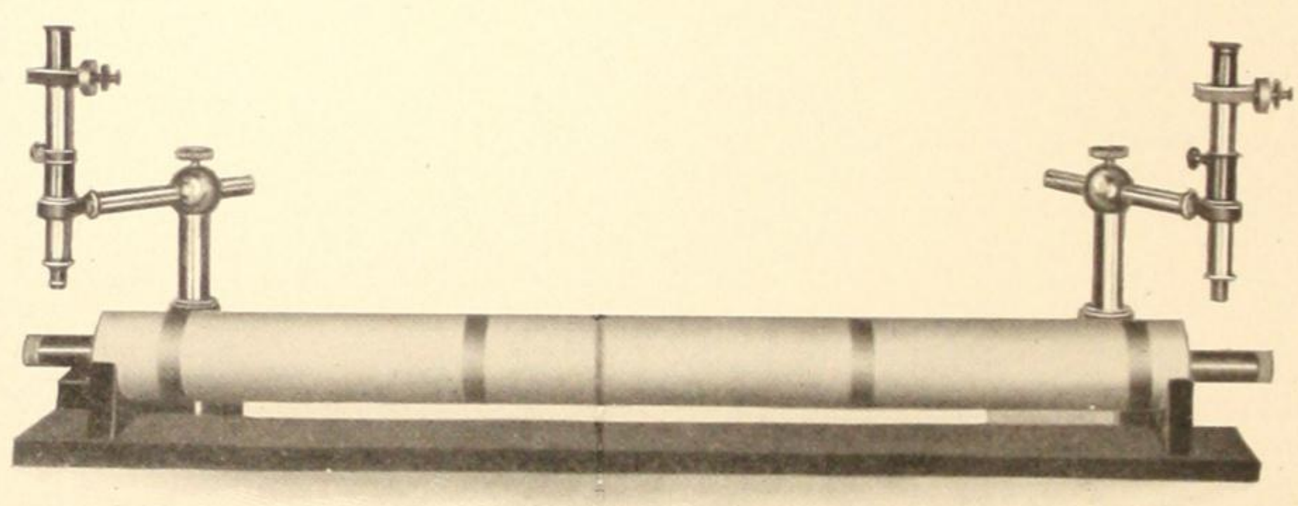


No. 301H.

301H. Linear Expansion Apparatus, Milvay. Tube Form. This tube is notched near one end and securely clamped to the right-hand support. Expansions for any tube length up to 60 centimeters can be taken. The micrometer screw head is graduated to read to hundredths of a millimeter. Parts "A," "B" and "C" are removable and will fit any of the tubes listed below. Complete with brass tube..**$9.00**

Extra Tubes for No. 301H

302H.	**Aluminum Tube**	**$0.75**
303H.	**Brass Tube**	**.75**
304H.	**Copper Tube**	**1.10**
305H.	**Steel Tube**	**1.10**

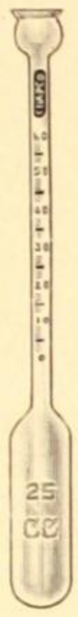


No. 306H.

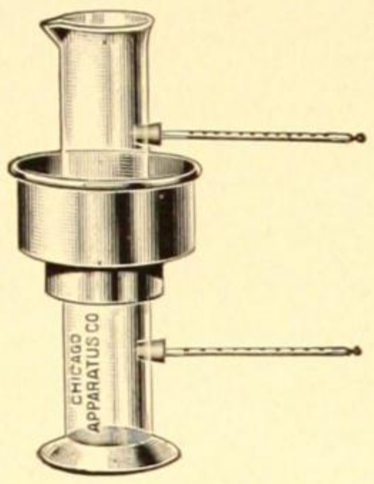
306H. Linear Expansion Apparatus, Precision Form (Gaertner). For determining the linear expansion of brass by the micrometer microscope method—a method which yields extremely accurate results. The brass tube has connections for the circulation of steam or water and has side openings near the ends for the insertion of thermometers. The whole tube is enclosed in a heavy felt-lined cylindrical box with removable cover. The microscopes employed to make the necessary measurements are pointed on two fine lines—100 cm. apart—engraved near the ends of the tube. The portions of the tube on which these lines are ruled are entirely covered. The thorough covering of the entire tube gives to the expanding element that uniformity of temperature, without which the fine results possible by the microscope method cannot be realized. Microscopes No. 4275M on Supports No. 4295M are recommended. Complete as illustrated, but without microscopes and their supports **$17.50**

307H. Copper Tube. For use in No. 306H in place of the brass tube.....**$7.00**

308H. Steel Tube. For use in No. 306H in place of the brass tube.....**$6.00**



No. 311H.



No. 316H.

311H. Liquid Expansion Apparatus. Glass. Capacity of bulb 25 cc. Capillary neck is graduated for 0.5 cc. in 100ths. The cubical expansion of a liquid is determined by observing the rise of the liquid in the capillary neck for a given rise in temperature **$2.00**

316H. Maximum Density of Water Apparatus. A glass cylinder 37.5 cm. high by 7.5 cm. in diameter with a copper reservoir for a freezing mixture. Holes are drilled above and below this reservoir for thermometers. When the jar is filled with water and a freezing mixture placed in the reservoir, the lower thermometer will fall to a temperature of 4° C, where it becomes stationary. Then the upper thermometer will begin to fall; but instead of stopping at 4° C it continues to fall to 0° C. Since the cooling is done in the middle, the only way in which the upper temperature could fall to 0° C would be through the rising to the surface of water both lighter and colder than 4° C. Our present design insures rapid action **$8.00**

Mechanical Equivalent of Heat Apparatus

319H. Mechanical Equivalent of Heat Apparatus, Milvay. For experimentally determining the value "J" by converting a measurable amount of mechanical energy into a measurable amount of heat. In use, the conical calorimeter fastened to the horizontal 25 cm. diameter wooden disc contains a measured amount of water at a known temperature. A second vessel or driving cup fitting snugly over this conical calorimeter is driven by a shaft attached to its lower end. The calorimeter is prevented from rotating by a couple applied by the cord which passes tangentially from the rim of the wooden disc over a pulley, carrying a known mass consisting of hanger and weights. The latter is adjusted to just prevent rotation and the total number of revolutions are ascertained from the initial and final readings of the revolution counter mounted on the base.

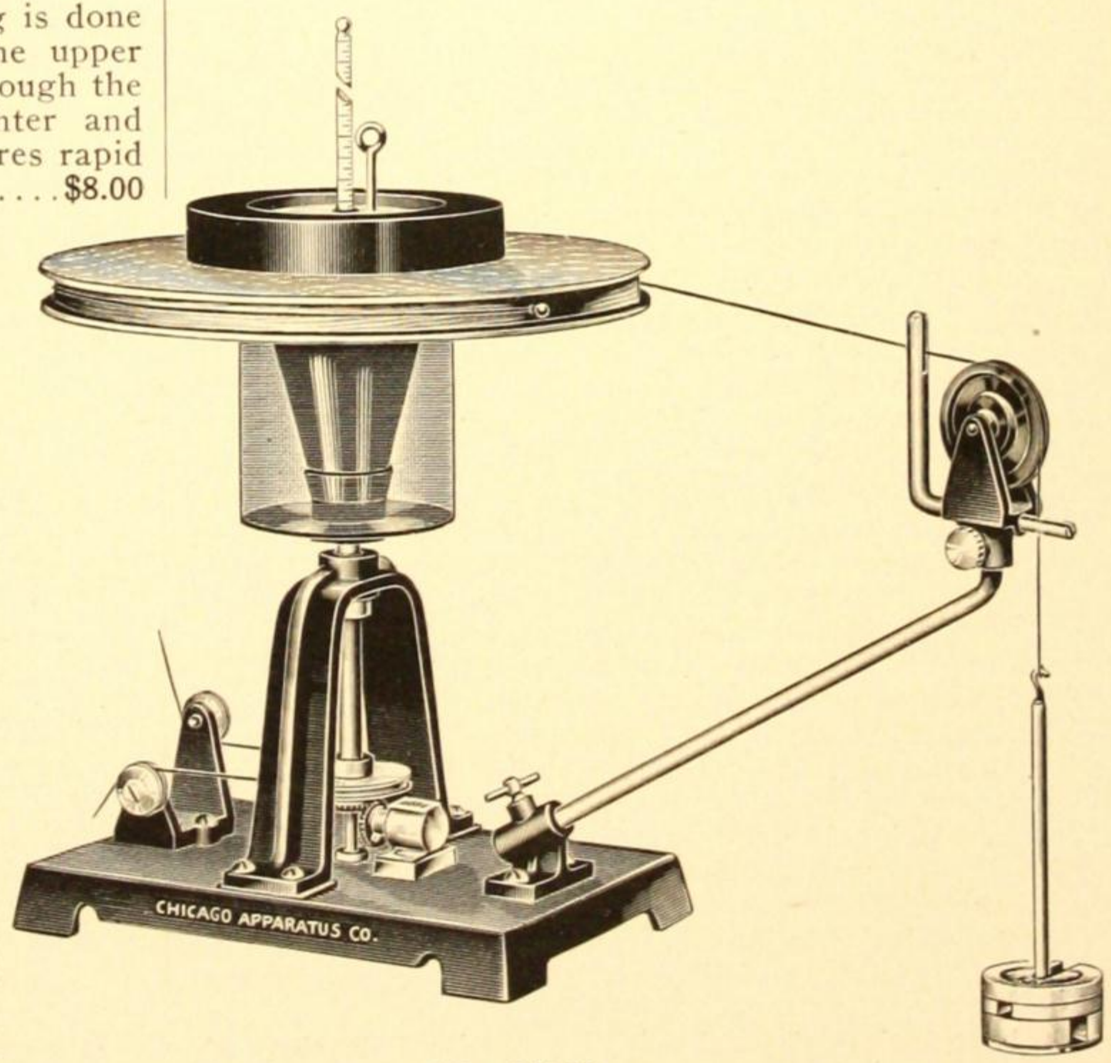
From the measured radius of the wooden disc, and the mass in grams of the counter-torque weights, the work done in the total number of revolutions can be readily calculated. From the temperature rise, the mass of the contained water, and the water equivalent of the calorimeter and driving cup, the number of heat units produced can also be easily calculated. The ratio of energy input to the heat produced—the value of J—is readily ascertainable from this calculated data.

To guard against losses and errors which would seriously falsify the final result, the outer driving cup and driving shaft have a heat insulator block between them, both calorimeter and driving cup are surrounded by a dead air space inclosed in a cylindrical shell, the disk is accurately turned and its dimensions easily measurable, the weight of the calorimeter and driving cup accurately determined and indicated, and the counter torque weights are accurately adjusted. For these reasons this apparatus yields excellent results.

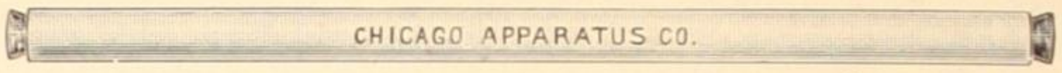
Our No. 892R Electric Rotator constitutes an excellent drive for this apparatus because of its fine speed control. Hand wheel drive No. 320H may also be used. For belting No. 80W Chalk Line is suitable.

The metal base measures 20x15 cm.; the revolution counter is the standard five-wheel type reading up to 99,999, the ring weight has a mass of about 1000 grams, and the overall height is 30.5 cm. Complete as illustrated, including stirrer, one No. 321B Weight Hanger, two No. 311B Weights, 50 gr.; one No. 311B Weight, 100 gram; ring weight, about 1000 gr.; bottle of lubricant for driving cup, cord, directions, but without thermometer..... **$50.00**

320H. Hand Wheel Drive. For No. 319H. Table clamp with vertical rod and 39.5 cm. diameter drive wheel with groove for chalk line belt..... **$11.00**



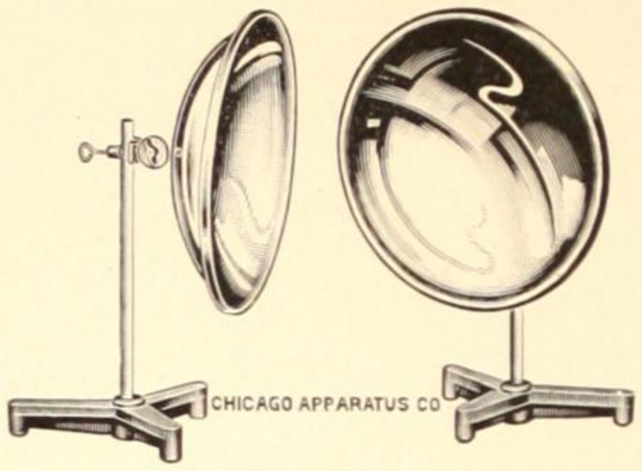
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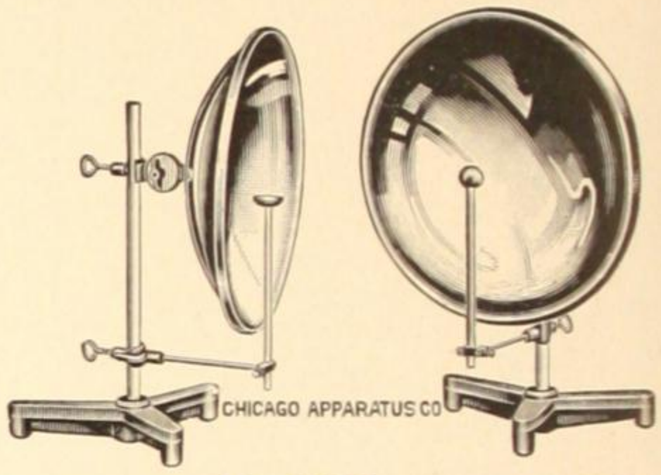
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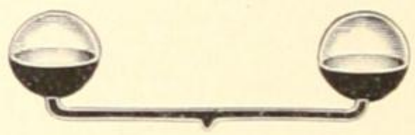
No. 323H.



No. 326H.



No. 331H.



No. 336H.

321H. Mechanical Equivalent of Heat Tube, Improved Form. As used in Millikan, Gale and Bishop's Course. Straight wound instead of spiral and therefore much stronger. Cannot open up under impact of falling shot like the spiral type and therefore prevents spilling of shot on the laboratory floor. Heavy paper tube, one meter long, provided with solid cork stopper for one end and a one-hole cork stopper for the other. From the rise in temperature of a known mass of shot when allowed to fall a known number of times through the length of the tube the mechanical equivalent is calculated....**$0.35**

323H. Molecular Demonstration Apparatus, Stoekle. This vacuum tube when heated over a Bunsen burner or over an electric heater gives an excellent demonstration of the thermal agitations of gaseous molecules as assumed in the kinetic theory of gases. Consists of a high vacuum tube of Pyrex glass containing a quantity of mercury and crushed blue-colored glass. The mercury, boiling at a low temperature, gives off vapor at a high velocity which carries with it particles of glass that move about in the space above the mercury, colliding with each other and the walls of the tube quite similar to the hypothetical motions of gas molecules. These motions are clearly visible up to a distance of several feet.

By placing the tube in front of a slit through which a powerful beam of light (sunlight or arc light) is allowed to pass, the range of visibility may be increased. If room be slightly darkened, the range may be still further increased.....**$2.50**

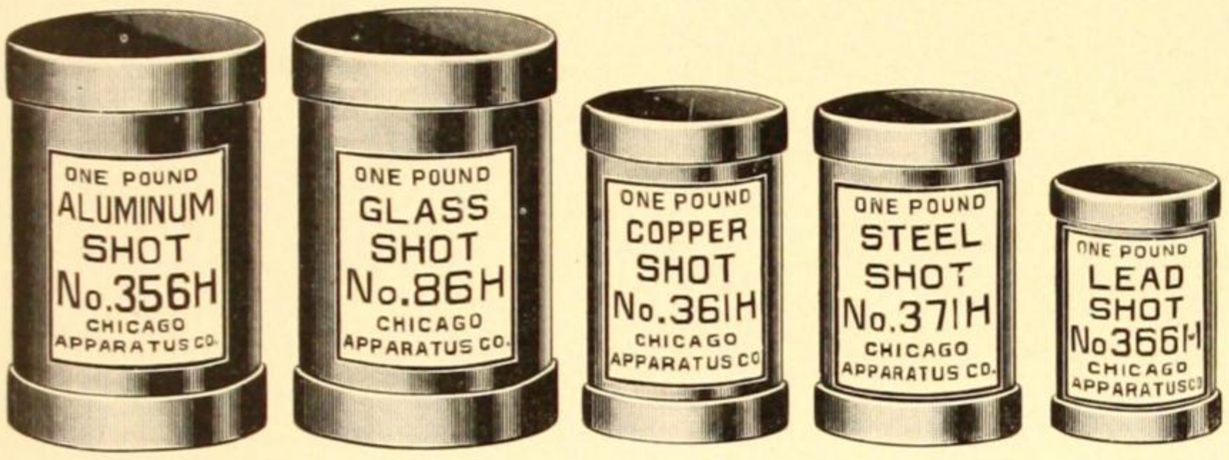
326H. Parabolic Reflectors of highly polished metal, 12 inches diameter. With Swivel Clamp Mounting. The clamps are of the adjustable swivel type, making possible the most accurate alignment of the reflectors. This is impossible with non-swivel clamps. The clamps are not attached directly to the backs of the reflectors, but to a special holder fastened to the rims. This eliminates all danger of destroying the parabolic surfaces by any strain at the back or by accidentally dropping them. Complete with supports **$12.00**

331H. Parabolic Reflectors and Sound Reflectors Combined. Highly polished metal reflectors, 12 inches in diameter, adjustably mounted on suitable supports. Complete with adjustable ball and phosphorus holder for heat experiments, and sensitive flame burner and Galton whistle holder for sound experiments. For complete description see Section "S." Complete as described, with supports....**$24.00**

336H. Pulse Glass, Franklin's. Two connected glass bulbs, partially filled with colored water. For exhibiting ebullition of a liquid at a low temperature (heat of the hand) in vacuum. Length about 17.5 cm. **$0.75**



Nos. 337H-338H.



Nos. 356H-371H.

337H. **Pyrometer.** For acquainting students with the methods of reading high temperatures employed in industry, and for practical purposes in the laboratory. It is useful for exploring surface temperatures of gas or electrically heated ovens, ranges, hot plates, toasters, etc.; for checking the temperatures of furnaces used in tempering, annealing, hardening, and pre-heating iron and steel; for exploring temperatures in drying and other ovens, electric furnaces, etc.; and for reading the temperatures of molten aluminum, tin, lead, solder, babbitt, spelter, brass, etc. Each class of work requires one of the three different thermocouples listed below. These are quickly attached and changed by loosening two set screws at the back of the instrument. Two temperature scales are provided, one reading from 100° to 1200° F, the other from 200° to 2000° F. Readings when thermocouples listed below are employed, are accurate to 2%. Without thermocouple..**$20.00**

338H. **Thermocouple for No. 337H.** This couple is illustrated attached to the pyrometer. It is intended for measuring surface temperatures of solids by contact. Equipped with solid silver contacts, providing almost instantaneous readings—5 to 10 seconds. For use in measuring temperatures from 100° to 1200° F. Overall length, including bent section, 12 inches **$5.00**

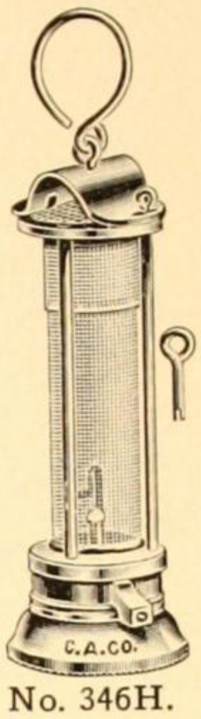
339H. **Thermocouple for 337H.** This type is for exploring the temperatures inside of furnaces, ovens, boiler flues, etc. For measuring temperatures from 200° to 2000° F. Overall length 24 inches....**$7.40**

340H. **Thermocouple for No. 337H.** For reading the temperature of molten non-ferrous metals such as aluminum, tin, lead, solder, babbitt, spelter, brass, antimony, bismuth, etc. The tip of this couple is not closed, the molten metal being depended upon to complete the contact at the hot junction. For measuring temperatures from 200° to 2000° F. Overall length, 36 inches **$12.00**

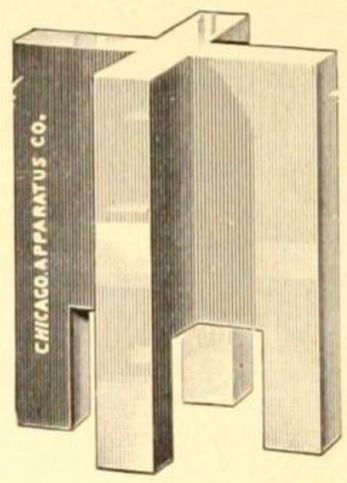
341H. **Radiometer.** For illustrating the conversion of radiant heat and light into mechanical energy. An exhausted glass globe in which is a needle point carrying a four-blade vane. The blades of this vane are bright on one side and black on the other. Placed in a field of light the vane will rotate rapidly. Mounted on glass base.....**$2.50**



No. 341H.



No. 346H.



Nos. 372H-374H.

346H. **Safety Lamp, Davy's.** Made entirely of metal. Commercial type as used in mines. About 25 cm. high **$4.00**

351H. **Shot, Aluminum.** For use in specific heat experiments. **Per 4 ounce package**.....**$0.30**

356H. **Shot, Aluminum.** For use in specific heat experiments. **Per pound package**.....**$0.85**

361H. **Shot, Copper.** For use in specific heat experiments. **Per pound package**.....**$0.55**

86H. **Shot, Glass.** (Beads.) For use in specific heat experiments. **Per pound package**.....**$2.00**

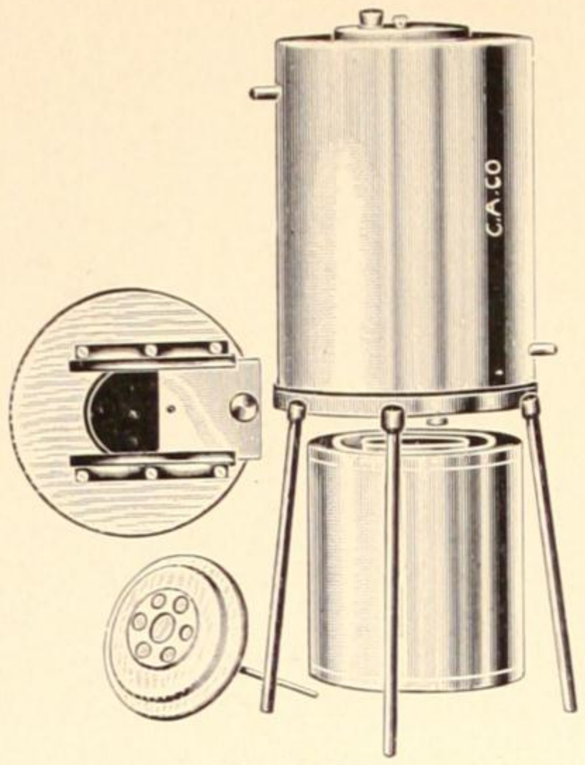
366H. **Shot, Lead.** For specific heat experiments. **Per pound package** **$0.40**

371H. **Shot, Steel.** For specific heat experiments. **Per pound package** **$0.30**

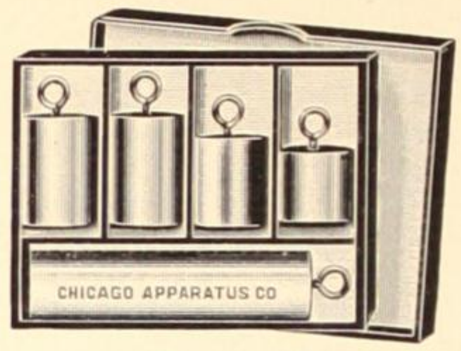
372H. **Specific Heat Body, Fin-Shaped, Aluminum.** This design has been used for some time in the Chicago High Schools in place of shot, and has given complete satisfaction. Allows free circulation of the water; heat penetrates rapidly—only one cm. of metal at thickest point; readily fits inside of smallest calorimeter and allows thermometer bulb to pass down into the water. Extreme height, 65 mm.; extreme diameter, 50 mm.; approx. weight, 175 grams. Made of cast aluminum.....**$0.75**

373H. **Specific Heat Body, Fin-Shaped, Copper.** Same shape and size as No. 372H, but made of cast copper. Approx. weight, 700 grams.....**$1.25**

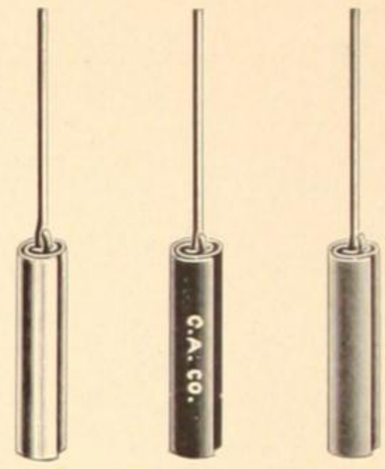
374H. **Specific Heat Body, Fin-Shaped, Iron.** Same shape and size as No. 372H, but made of cast iron. Approx. weight, 500 grams.....**$0.35**



No. 370H.



No. 375H.



No. 378H.

370H. Specific Heat Apparatus. McCall's. To secure accuracy in the determination of specific heat two things are very important. First, both heating chambers and calorimeter must be thoroughly heat insulated; secondly, the transfer of the material under test, from heating chamber to calorimeter, must be made quickly and without bringing it into contact with the cooler outside air. Prof. A. G. McCall solved this nicely in the apparatus which he designed for the determination of the specific heat of soils, and which apparatus is likewise suitable for making similar determinations of the materials or "bodies" employed in physics work.

The heating chamber consists of a double-walled copper vessel with very thick felt insulation, and with steam inlet and outlet as indicated in the illustration. The cover at the top is provided with rubber stopper for thermometer and means for suspending the test body. At the bottom is a sliding door, which when pulled to one side as illustrated, permits the body to be quickly lowered into the calorimeter placed directly underneath it. The latter is a double-walled calorimeter (No. 101H) mounted in a large copper vessel with very thick felt insulation inside around the sides and bottom. Thus, the test body is heat insulated by being completely surrounded by a wide air space and a thick layer of felt.

Complete, as illustrated, with calorimeter cover, stirrer and tripod, but without thermometer..**$30.00**

370HC. Calorimeter only of No. 370H, but without thermometer **$9.00**

375H. Specific Heat Specimens, Milvay. For showing that it requires wholly different amounts of heat energy to produce in equal masses of different substances the same change in temperature. Each cylinder weighs the same (about 70 grams), is 19 mm. in diameter, and provided with hook. The set includes one cylinder each of lead, copper, tin, zinc and aluminum. Suggestion for use: After attaching a thread to the hook of each cylinder let them be placed for ten or fifteen minutes in boiling water. Let two or more vessels (preferably thermos bottles) be provided, each of which contains the same amount of water to a depth of not less than 9 cm., and at room temperature. Let a heated cylinder be lowered into the first vessel, and after the insertion of a thermometer let the rise in temperature of the water be noted. Let the same be done with the other cylinders. The aluminum will be found to raise the temperature about twice as much as the copper or zinc, four times as much as the tin, and seven times as much as the lead. Obviously, since in each case the amount of the water and weight of the cylinder was the same, the rises in temperature must be proportional to the specific heats of the various metals.

These cylinders are also useful in showing the relative size of equal masses of substances of different specific gravities. Since each cylinder is the same in weight and diameter, it follows that their lengths must be inversely proportional to their densities. As described, per set, in compartment box **$2.50**

378H. Specific Heat Specimens. Roll Form. For use, in connection with calorimeters and thermos bottles, in specific heat determination work. Made from sheet metal in the form of open rolls with attached wire for convenience in handling. Because of their large contact area, transference of heat between them and the liquid in which they are immersed is very rapid—a matter of a few seconds. Furthermore, because of their resiliency, they are less likely to cause damage when used with thermos bottles. The outside dimensions are about 60x15 mm.

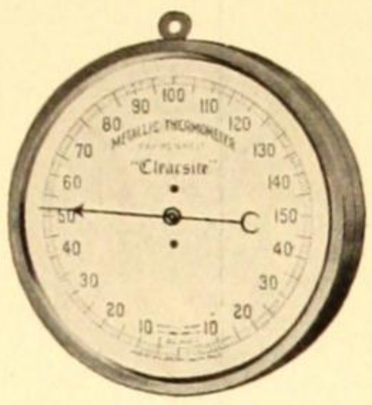
No.	A	B	C	D	E	F
Metal	Lead	Copper	Brass	Nickel	Aluminum	Zinc
Each	**$0.50**	**.50**	**.50**	**.50**	**.50**	**.50**



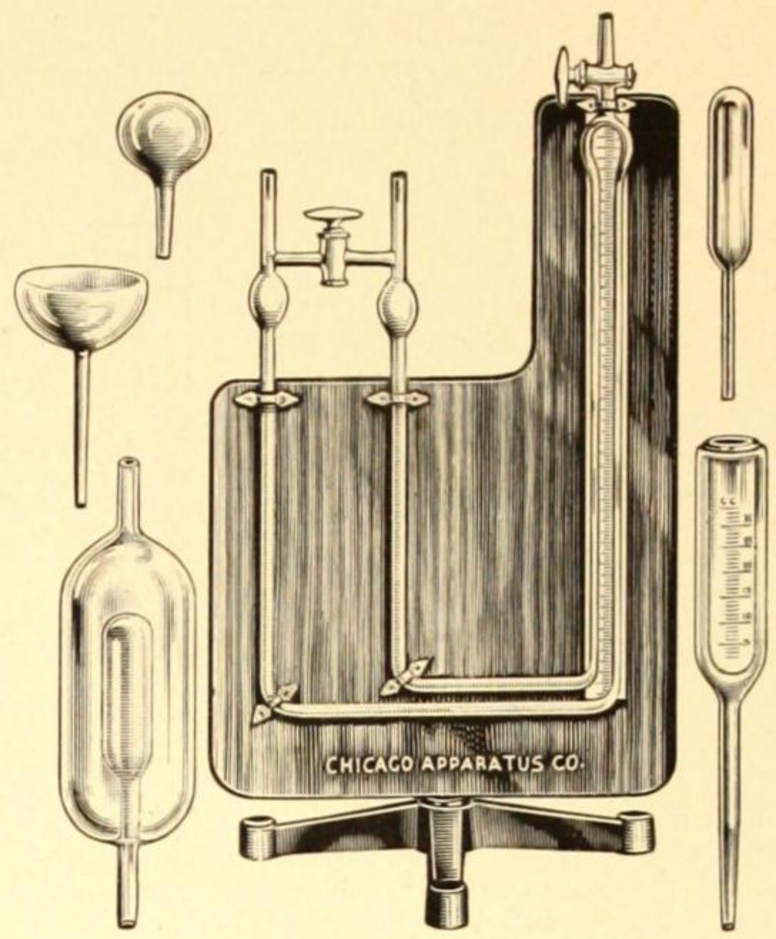
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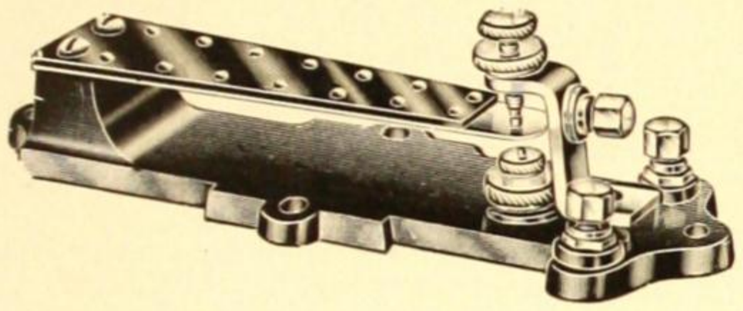
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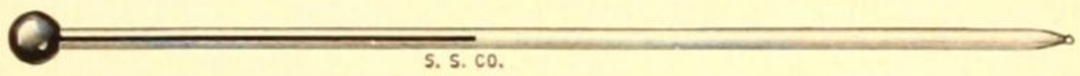
No. 382H.



No. 384H.



No. 385H.



No. 383H.

376H. Thermo-Couple. Simple form. Brass and German silver, 10x1.5 cm., with wires.....**$0.45**

381H. Thermo-Couple. A pair of metal bars, antimony and bismuth, 100x10x10 mm., so joined as to produce a thermo-electric current when their junction is heated or cooled. Bars are provided with wire terminals so that they can be readily connected into a galvanometer circuit. On metal stand **$3.50**

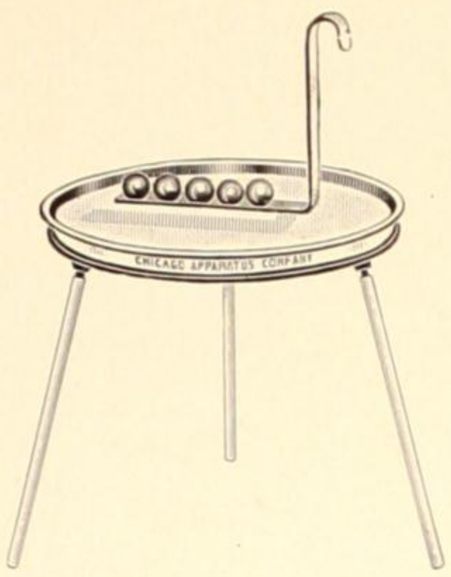
382H. Thermometer, Metallic, Demonstration Form. Round pattern, with glass back to show internal mechanism, 6-inch dial, range—50 to 150 degrees Fahrenheit. A spiral coil of two metals soldered together and connected with an index hand by a multiplying lever constitutes the mechanism which responds to temperature changes—a fine practical application of expansion due to heat.....**$4.25**

383H. Thermometer, Ungraduated. Translucent back, stem for graduation from 0 to 100 degrees C, filled with mercury, but without graduations. Ideal for student use in thermometry **$0.90**

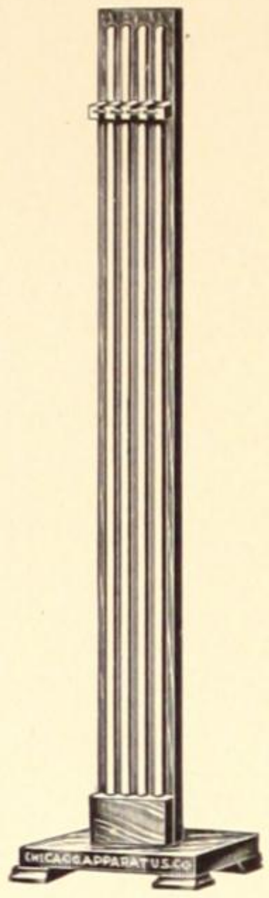
384H. Thermoscope, Rendtorff's Form. Designed by Prof. E. J. Rendtorff of Lake Forest Academy for measuring heat reactions and comparing heat sources. Mounted on a vertical board supported on a tripod. Overall height is about 40 cm. Directions describing 96 experiments—most of them quantitative—are included. They illustrate the principles of absorption, conductivity, specific heat, change of heat, radiant heat, vapor pressure, electrical reactions and chemical reactions. Complete with eight special bulbs—two each of the three plain shapes shown in the upper portion of the illustration and one each of the two double types shown in the lower portion—and complete directions **$24.00**

385H. Thermostat, Adjustable. For use in an electric circuit. Can be set to make contact at temperatures up to 50 degrees C. May be used to operate call bells, fire alarms and other electrical devices. These may be placed in the circuit at any desired distance from the thermostat on 16 cm. by 5 cm. base **$2.75**

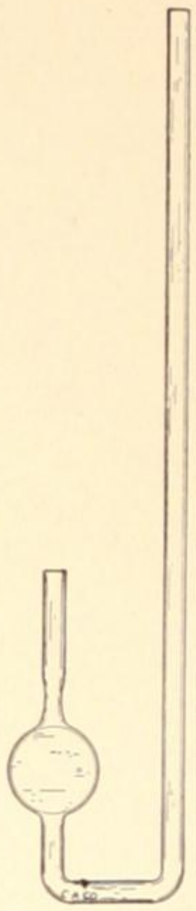
391H. Touch Paper. For producing the smoke needed in Nos. 186H and 191H Convection Apparatus. In sheets about 25x25 cm. **Per sheet**.....**$0.10**



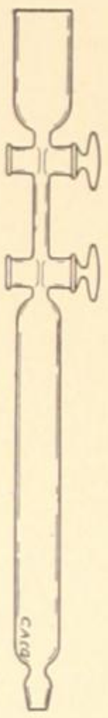
No. 396H.



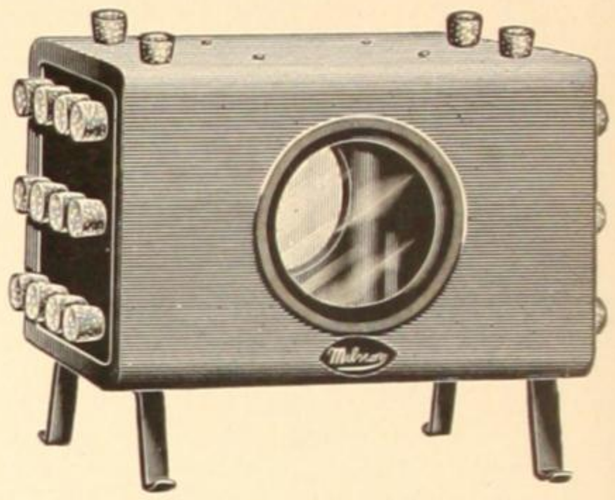
No. 401H.



No. 404H.



No. 405H.



No. 416H.



CHICAGO APPARATUS CO.

No. 406H.

396H. Tyndall's Specific Heat Apparatus. Five balls of different metals; ball holder, paraffine cake, tripod; metal pan—25 cm. in diameter—for catching the balls and remolding the paraffine cake. The balls placed on the holder, heated in boiling water, and then dropped on paraffine cake melt through it at rates depending on their specific heats....**$3.00**

401H. Vapor Pressure Apparatus. A support with four No. 55S Barometer Tubes, iron mercury well and curved pipette for introducing the liquids under test into the tubes. The design of the mercury well makes it necessary to use only a small amount of mercury with this apparatus.....**$7.00**

402H. Vapor Pressure Apparatus. Same as No. 401H, but with reservoir and stopcock at the top of each tube, making it much easier to introduce the liquids under test. Tubes are ungraduated.....**$14.00**

404H. Vapor Pressure Apparatus. Millikan's Form. Tube 110 cm. long with bulb 6 cm. in diameter. For determining the variation of the boiling point with pressure by the static method.....**$3.00**

405H. Vapor Tension Tube. To be substituted for the air thermometer bulb of No. 245R Boyles' Law Apparatus so that it may be used for determining the vapor tension of water, alcohol, ether, acetone, etc. This tube is 35 cm. long and is provided with a reservoir at the top and a constriction at the bottom which fits the short hose that normally holds the air thermometer bulb in place. The two stopcocks are for creating a vacuum space above the mercury and for introducing the volatile liquid into this space, without the entry of air. The capillary tube between the stopcocks is for measuring off the small amount of volatile liquid required for the test. With this tube in place on No. 245R and with both stopcocks open the mercury is raised to the upper stopcock which is then closed. Next, the mercury column is lowered to a point below the lower stopcock which is then closed leaving a vacuum space above the mercury and in the capillary tube. The volatile liquid is poured into the reservoir, the top stopcock again opened and after the capillary has filled, again closed. The lower stopcock is now again opened and the volatile liquid enters the vacuum space above the mercury. Its tension is then measured by the pressure it exerts against the mercury column.....**$4.00**

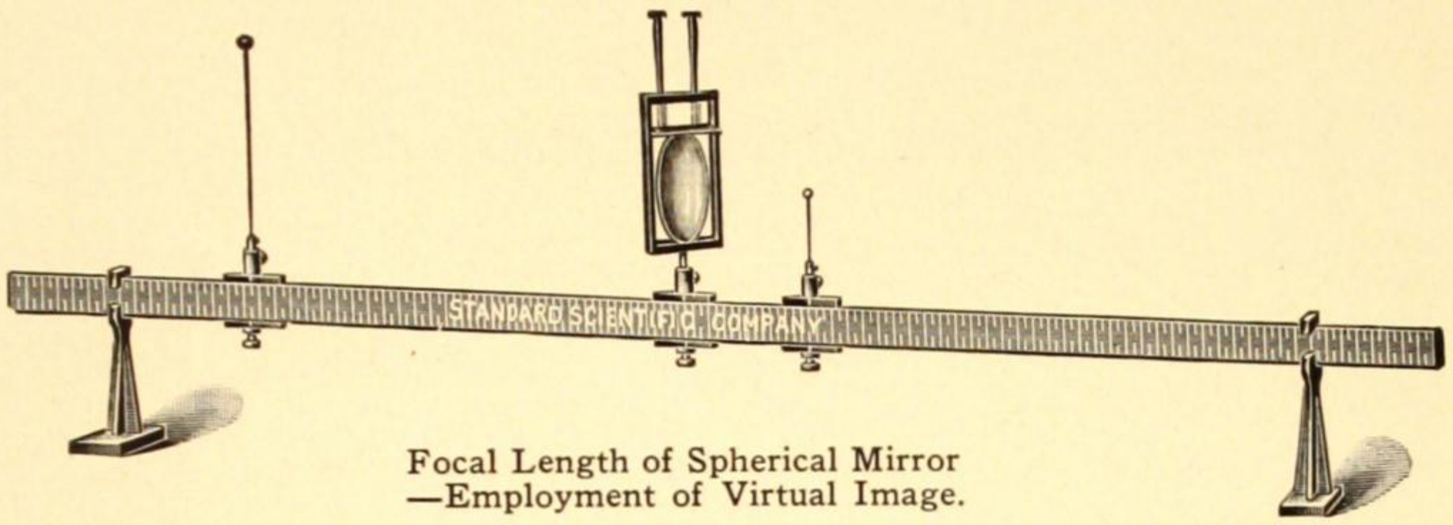
406H. Volume Coefficient Tube. Charles Law or Gay Lussac's law tube. A capillary glass tube about 45 cm. long, sealed at one end and containing a column of dry air confined by a short mercury index **$0.60**

411H. Volume Coefficient Tube. Same as No. 406H, but unfilled **$0.30**

416H. Ventilation Apparatus, Milvay. Designed after Prof. Earl R. Glenn, Lincoln School of Teachers College, New York City. When all twelve openings are closed, it is absolutely airtight and will quickly extinguish a lighted candle. This cannot be shown with other models. By holding a smoking object (Touch Paper) near the holes, the course of the air into and out of the openings can be clearly shown. The candle holder is movable so that the best ventilation for dfferent candle positions may be shown. The box measures 9x6x6 inches and is finished in black. It is provided with two airtight windows for viewing the candle and is mounted on a neat metal stand. One end of the box is removable for inserting and lighting the candle. Complete with cords, candle holder and candle....**$7.50**

Farwell-Stifler Optical Bench

Section J



Focal Length of Spherical Mirror —Employment of Virtual Image.

This optical bench was introduced some years ago by the Standard Scientific Company of New York City.* It has given such splendid satisfaction wherever used that we have found it advisable to continue its manufacture and to stock it in larger quantities than ever, to meet the steadily increasing demand. The Farwell-Stifler Optical Bench is entirely different, offers many exclusive advantages, and a much wider range of utility than any other design:

1. With it many experiments impossible with other benches are easily performed.

2. It is highly satisfactory for both elementary and advanced work.

3. The design of each individual part has been worked out to such a nicety that any required set-up can be quickly and easily made.

4. Bench legs are much heavier than usual and, therefore, impart greater stability. Being also higher, they provide a more comfortable working space between the edge of the graduated bar and the table top.

5. All parts which project above the bench rod are made as light as possible to avoid top heaviness, without sacrificing strength or durability.

6. The holder—the most important part in any optical bench—is unique in many ways. It is universal in the strictest sense of the word. Spring pressure applied against the movable jaw securely holds any lens, screen, or mirror up to 80 mm. in diameter. Both the movable and stationary jaws have deep V-grooves in them. These V-grooves automatically align screens, lenses, or mirrors in the central plane of the holder, which plane coincides with the index line on the sliding clamp. In view of this construction the optical distances between lenses, mirrors, and screens are accurately indicated on the graduated bench. It accounts for the excellent results obtained with this outfit.

7. The price is very low considering that it is suitable for all optical bench work; that is accurately built to standards so that all parts are easily interchangeable; and that is comprised of parts, which, when assembled, have sufficient stability to enable adjustments to be made without danger of overturning the bench. Quantity production in our well equipped, modern plant makes this low price possible.

With a No. 1275J Farwell-Stifler Optical Bench and the No. 1285J Farwell-Stifler Accessory Outfit, listed on page 188, the following eighteen elementary experiments can be performed to the best possible advantage.

1. To locate the position of the image in a plane mirror.

2. To find the focal length of a concave mirror by direct method.

3-1. To find focal length of concave mirror by method of conjugate foci when image is real.

3-2. To find focal length of concave mirror by method of conjugate foci when image is virtual.

4. To find focal length of convex mirror by direct method.

5. To find the focal length of a convex mirror by the method of conjugate foci.

6. To find the focal length of convex lens by direct method.

7. To find the focal length of convex lens by the aid of a plane mirror.

8. Focal points of a thin convex lens.

9-1. To find focal length of convex lens by the method of conjugate foci when image is real.

9-2. To find focal length of convex lens by the method of conjugate foci when the image is virtual.

10. To find focal length of a concave lens by direct method.

11. To find the focal length of a concave lens by the method of conjugate foci.

12. To locate the image of a virtual object.

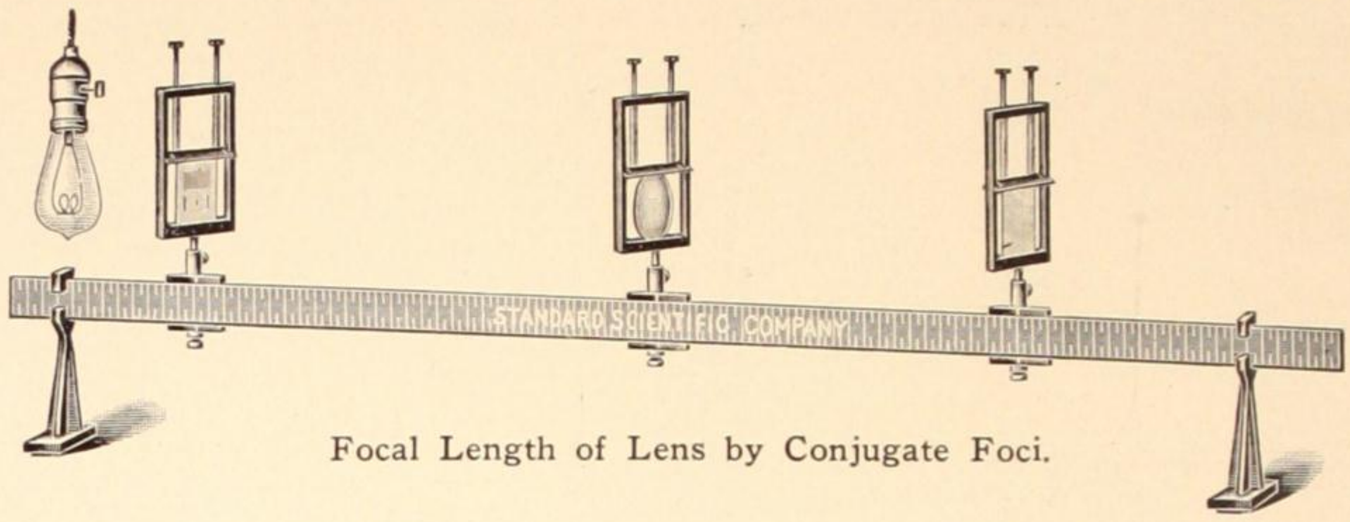
13. To find the focal length of a convex mirror when the object is virtual.

14. To find focal length of concave lens when object is virtual.

15. Principle of Astronomical Telescope.

16. Principle of Compound Microscope.

*Through purchase, we acquired the business of the Standard Scientific Company in 1924.



Focal Length of Lens by Conjugate Foci.

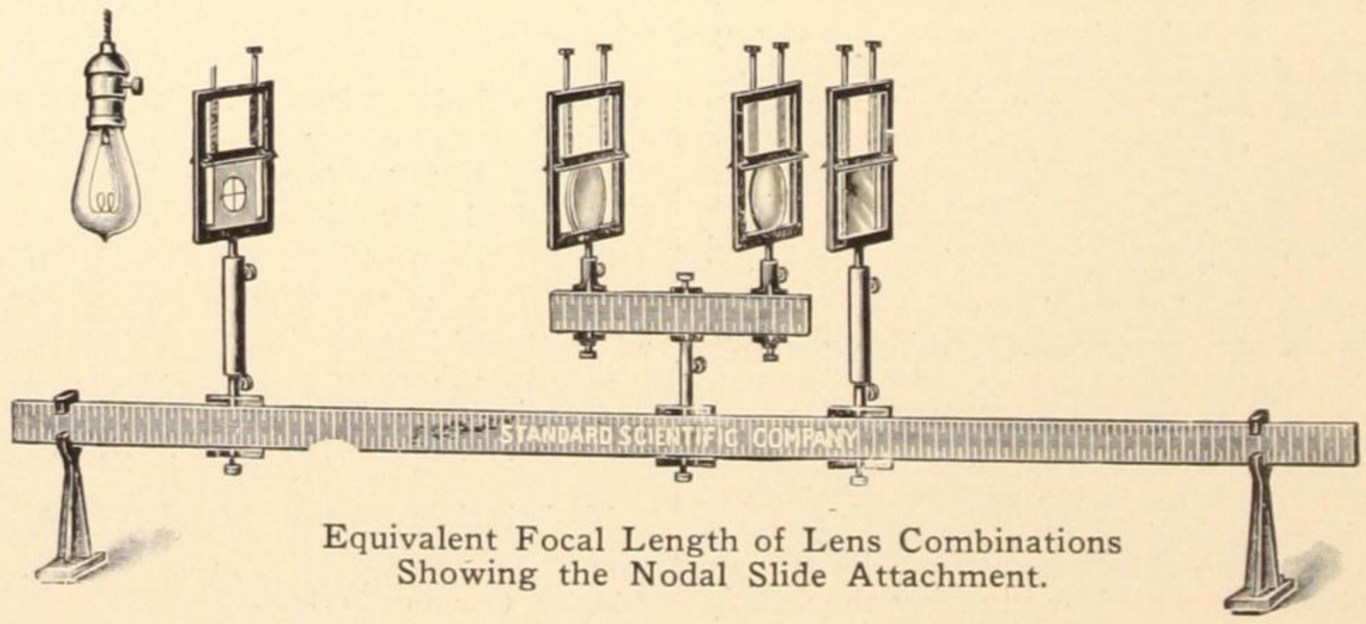
The Farwell-Stifler Optical Bench is also admirably suited for more advanced work. Merely for the purpose of indicating the adaptability of this apparatus we list below a few of the experiments possible with the No. 1275J Farwell-Stifler Optical Bench and the Accessories for Advanced Work listed below:

No. 1-1. Virtual image in a plane mirror.
No. 1-2. Virtual image in a positive or convex lens.
No. 1-3. Virtual image in a negative or concave lens.
No. 2. Measurement of focal length of combination of two lenses.
No. 3-1. Convex lens with rear stop midway between lens and focal plane.
No.3-2. Convex lens with rear stop in focal plane.
No. 3-3. Convex lens with rear stop beyond the focal plane.
No. 3-4. Combination of two convex lenses with interior stop.
No. 4. Phenomena of spherical aberration and astigmatism.
No. 5. Wave length of light by diffraction.
No. 6. Optometry.
No. 7. Measurement of radius of curvature by reflection.

Each Farwell-Stifler Optical Bench outfit is accompanied by a twenty-four page illustrated booklet describing in detail the many experiments in which it may be used. With the many suggestions contained in this booklet it is easy to see how the Farwell-Stifler Optical Bench can be adapted to practically every optical experiment, regardless of text or manual used, in both elementary and advanced work.

1275J. Farwell-Stifler Optical Bench. Consists of 2 No. 1320J Bench Supports; 1 No. 364M Graduated Two-Meter Bar; 3 No. 1322J Sliding Clamps; 3 No. 1324J Universal Holders; 1 set No. 1340J Assorted Pins. With this equipment and the addition of lenses, mirrors and screens, found in most physics laboratories, all elementary experiments in optics can be performed. With the addition of No. 1285J Accessory Outfit, listed below, all of the eighteen elementary experiments, mentioned on the previous page, can be performed. These experiments are illustrated and described in detail in a twenty-four page booklet which is included with each Farwell-Stifler Optical Bench outfit.....**$10.40**

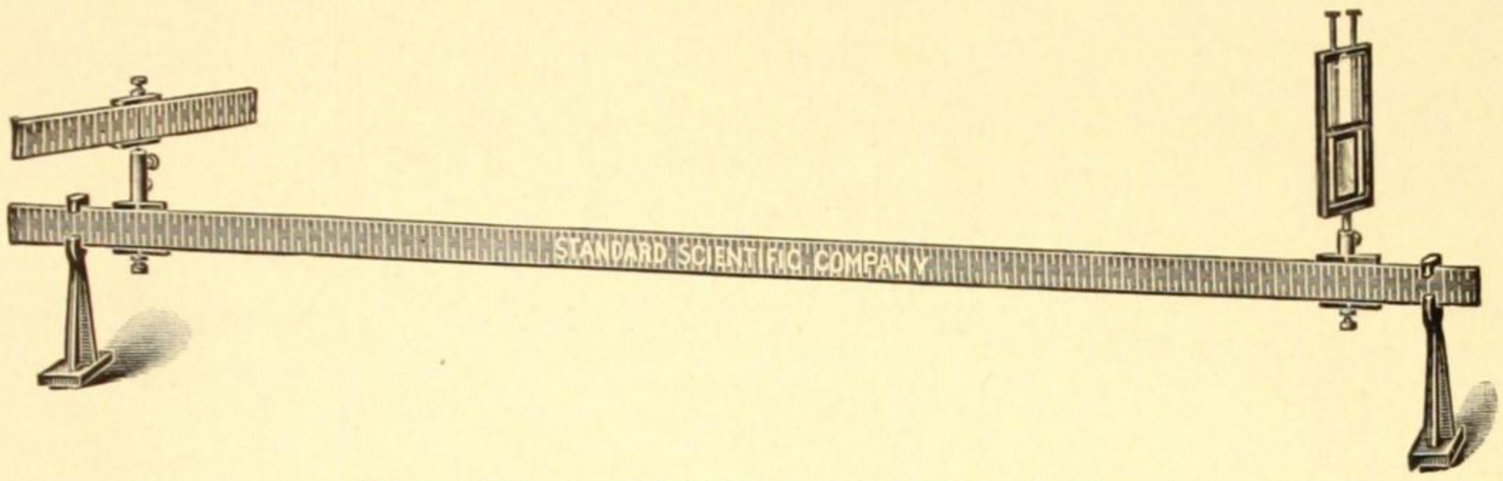
1285J. Farwell-Stifler Accessory Outfit. Consists of 2 No. 780J Convex Lens, 15 cm. focus; 2 No. 1328JA Ground Glass Screens, plain; 2 1328JB Ground Glass Screens, graduated; 1 No. 780J Convex Lens, 25 cm. focus; 1 No. 1330JA Opaque Screen, plain; 1 No. 1330JB Opaque Screen, perforated; 1 No. 785J Concave Lens, 25 cm. focus; 1 No. 780J Convex Lens, 35 cm. focus; 1 No. 46J Protected Back Convex Mirror; 1 No. 45J Protected Back Concave Mirror; 1 No. 9J Plain Mirror; 2 No. 1326J Pin Supports. With these accessories, in addition to No. 1275J Farwell-Stifler Optical Bench, all eighteen elementary experiments, mentioned on the previous page, can be performed. These experiments are illustrated and described in detail in the comprehensive twenty-four page booklet accompanying this outfit **$14.75**



Equivalent Focal Length of Lens Combinations
Showing the Nodal Slide Attachment.

Farwell-Stifler Optical Bench

Suggested Equipment Sets



Wave-Length of Light by Diffraction Grating.

1300J. Farwell-Stifler Optical Bench. Including 1 No. 364M two-meter bar with brass ends, 3 No. 1320J Bench Supports, 3 No. 1322J Sliding Clamps, 3 No. 1324J Universal Holders, 2 No. 1326J Pin Holders, 1 No. 1340J Set of Pins, and 1 No. 1337J Copy of Laboratory Exercises in Optics. Complete....**$11.80**

1305J. Farwell-Stifler Optical Bench. Same as No. 1300J, but including 1 No. 1336J Nodal Slide Equipment. Complete. **$17.80**

1306J. Farwell-Stifler Optical Equipment. Including 1 each No. 780J Double Convex Lenses, 15 cm., 25 cm. and 30 cm. focus; 1 each No. 785J Double Concave Lenses, 15 cm. and 25 cm. focus; 1 No. 9J Plane Mirror, 1 No. 45J Concave Mirror, 1 No. 46J Convex Mirror, 1 No. 1328JA Plain Ground Glass Screen, 1 No. 1328JB Ruled Ground Glass Screen, 1 No. 1329J Ground Glass Screen 75x75 mm., 1 No. 1330JA Opaque Screen, and 1 No. 1330JB Screen with Arrow. Complete **$13.50**

1308J. Farwell-Stifler Optical Bench. Including 2 No. 1320J Bench Supports, 5 No. 1322J Sliding Clamps, 2 No. 1324J Universal Holders, 1 No. 1340J Set of Four Pins, 1 No. 9J Plane Glass Mirror, 1 No. 1350J Vertex Pointer, 1 No. 1328JA Ground Glass Screen, 1 No. 1337J Copy of Laboratory Exercises in Optics. (The above equipment will fit any standard meter stick like our Nos. 358M, 363M and 364M.) Without meter stick **$9.95**

1310J. Farwell-Stifler Optical Bench. Including 1 No. 363M One-Meter Bar with brass ends, 2 No. 1320J Bench Supports, 3 No. 1322J Sliding Clamps, 3 No. 1324J Universal Holders, 2 No. 1326J Pin Holders, 1 No. 1340J Set of Pins, and 1 No. 1337J Copy of Laboratory Exercises in Optics.....**$9.45**

1315J. Farwell-Stifler Optical Bench. Same as No. 1310J, but including 1 No. 1336J Nodal Slide Equipment. Complete **$15.45**

1316J. Farwell-Stifler Optical Bench and Accessories. Including 1 No. 1300J Bench, 1 No. 1331J Set of Four Screens, 1 No. 790J Set of Five Lenses, and 1 No. 48J Set of Three Mirrors. Complete **$25.50**

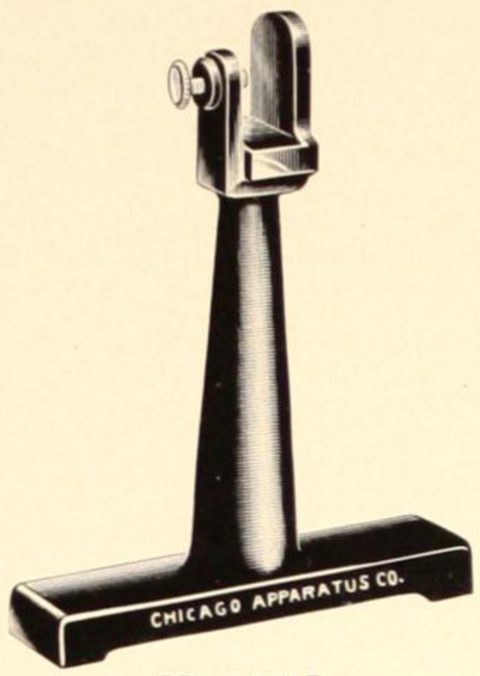
1317J. Farwell-Stifler Optical Bench and Accessories. Including No. 1316J Bench and Accessories, 1 No. 1332J Half Meter Stick for use with diffraction grating, 1 No. 77K Diffraction Grating, and 1 No. 1336J Nodal Slide Equipment. Complete **$37.00**

1318J. Farwell-Stifler Minimum Bench Equipment. Including 2 No. 1320J Bench Supports, 2 No. 1324J Universal Supports, 3 No. 1322J Sliding Clamps, 1 No. 1340J Set of Pins, 1 No. 1334J Screen with Arrow, 1 No. 780J Double Convex Lens, 35 cm. focus, 1 No. 780J Double Convex Lens, 15 cm. focus, 1 No. 1328JB Ruled Ground Glass Screen, 1 No. 1330JA Opaque Screen, 1 No. 9J Plane Mirror, and 1 No. 363M One-Meter Bar with brass ends. Complete **$12.75**

1319J. Farwell-Stifler Minimum Bench Equipment. Same as No. 1318J, but with 1 No. 364M Two-Meter Bar with brass ends in place of the One-Meter Bar **$14.10**

1337J. Laboratory Exercises in Optics. This 24-page book is the most complete and authentic of its kind ever published. It is profusely illustrated and gives explicit directions for performing many elementary and advanced experiments in optics with the Farwell-Stifler Optical Bench. **Per Copy**.....**$0.25**

Complete List of Parts and Accessories for the Farwell-Stifler Optical Bench



No. 1320J.



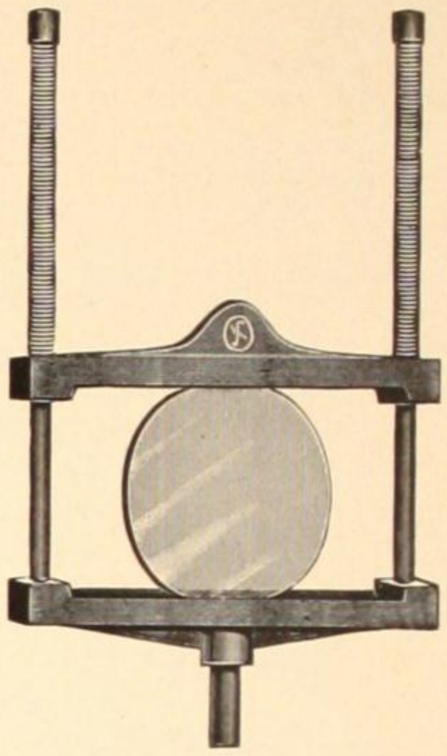
No. 1322J.



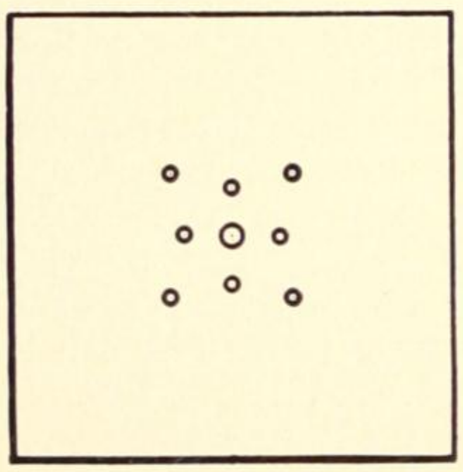
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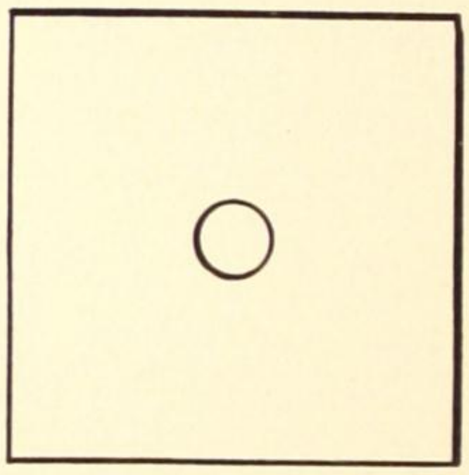
No. 1328JB.



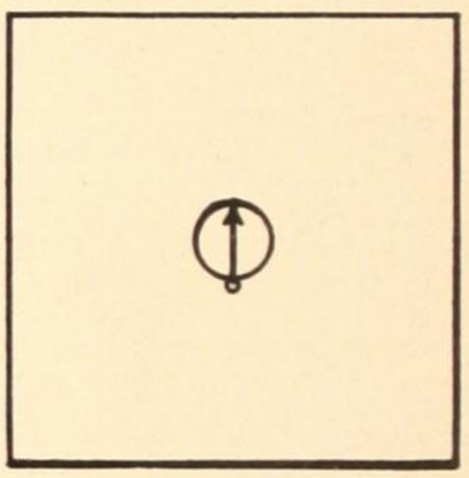
No. 1324J.



No. 1327J.



No. 1330JA.



No. 1330JB.

1320J. Farwell-Stifler Bench Support, for meter stick, with clamping screw. **Each** **$1.00**

1322J. Farwell-Stifler Sliding Clamp, with set-screw and index mark for supporting Universal Holder 1324J, Pin Holder 1326J, etc. Fits meter stick. **Each** **$0.75**

1324J. Farwell-Stifler Universal Holder, with spring clamp, for lenses, mirrors, screens, etc., measuring up to 3 in. diam. Fits 1322J. **Each** **$1.25**

1326J. Farwell-Stifler, Pin Holder, to fit Sliding Clamp 1322J. **Each** **$0.20**

364M. Meter Stick, two meters long, brass ends **$2.00**

363M. Meter Stick, one meter long, brass ends.. **.65**

368M. Coupling, for clamping, end to end, two of the one-meter sticks, to replace the two-meter stick for optical bench work **$1.00**

1327J. Ray Screen, 75x75 mm., metal, with small concentric holes, for observing the paths of the rays from lenses or mirrors, when smoke is used. Fits 1324J **$0.50**

1328JA. Ground Glass Screen. Plain, 38x75 mm. Fits 1324J **$0.10**

1328JB. Ground Glass Screen. Ruled, same as No. 1328JA, but with scale in millimeters and centimeters. Fits 1324J **$0.50**

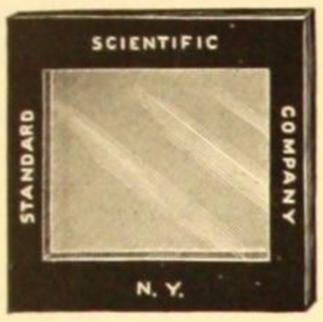
1329J. Ground Glass Screen. Plain, 75x75 mm. Fits 1324J **$0.15**

1330JA. Opaque Screen. One face white, the other black, 75x75 mm., with circular aperture 1.5 cm. diameter. Fits 1324J **$0.25**

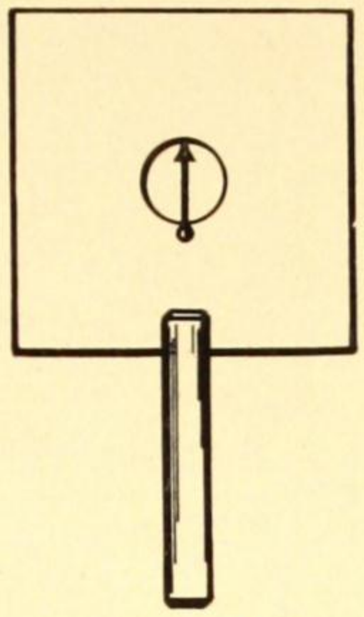
1330JB. Opaque Screen. Same as No. 1330JA, but with addition of arrow as illustrated. Fits 1324J **$0.45**

1331J. Set of Screens, for optical bench experiments, including 1328JA and B; 1330JA and B **$1.30**

1332J. Metric Scale, with central slit, for use with grating 77K in measuring wave-length of light **$3.50**



No. 77K.



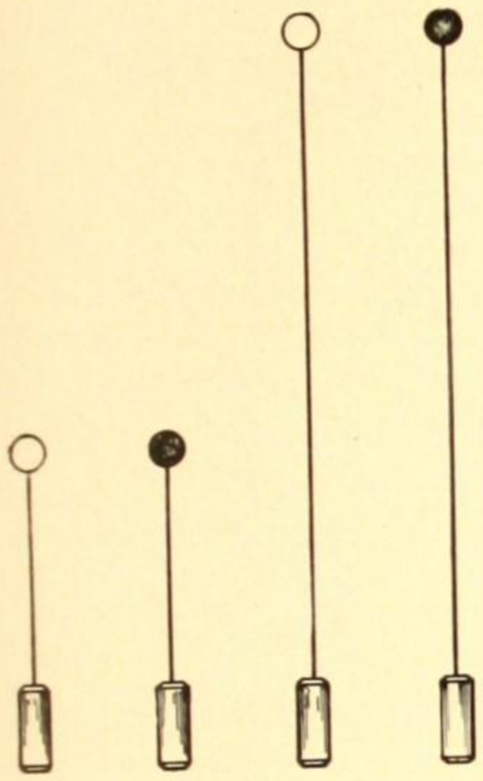
No. 1334J.



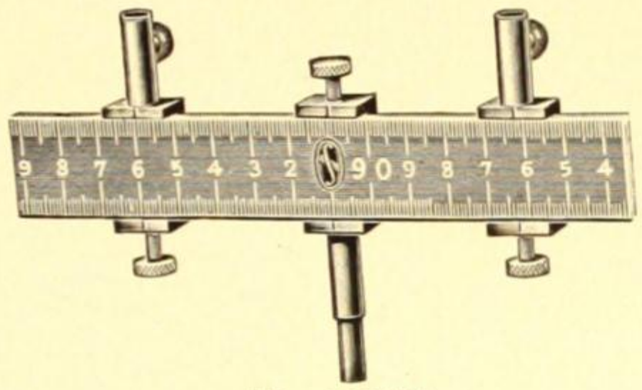
Nos. 40J-45J.



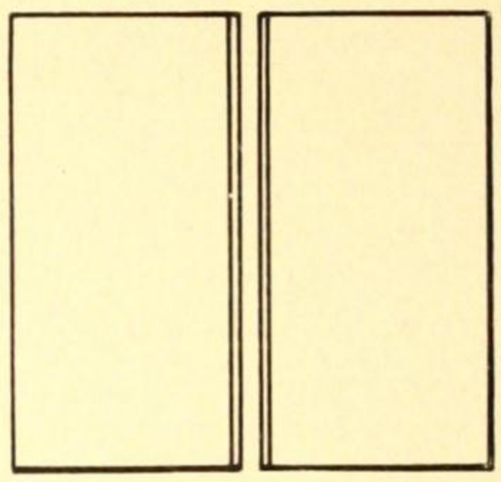
No. 46J.



No. 1340J.



No. 1336JA.



No. 1380J.

77K. Diffraction Grating, gelatine replica. Fits 1324J Universal Holder listed on page 190 ..... **$2.00**

1333J. Riders, coated white, to fit Half-Meter Stick 1332J, for use in locating the position of slit or color bands in experiments with the Diffraction Grating 77K. **Pair** **$0.20**

1334J. Object (Arrow) with Screen, mounted on stem. Fits Sliding Clamp 1322J **$0.50**

9J. Plane Glass Mirror, high grade, 75x75 mm. Fits 1324J **$0.20**

40J. Spherical Glass Mirror, concave, 80 mm. diam., 80 cm. focus, with metal rim. Fits 1324J **$1.75**

45J. Spherical Glass Mirror, concave, 80 mm. diam., 15 cm. focus, with metal rim. Fits 1324J **$1.75**

46J. Spherical Glass Mirror, convex, 80 mm. diam., 15 cm. focus, with metal rim. Fits 1324J **$1.75**

48J. Set of Mirrors, for the Optical Bench experiments, including: Plane Mirror 9J, Spherical Concave Mirror 45J and Spherical Convex Mirror 46J **$3.70**

1375J. Platform, 100x100 mm., with stem to fit Sliding Clamp 1322J, provided with clips for holding refraction plates or prisms firmly in position... **$3.50**

1380J. Adjustable Slit, consisting of 2 metal plates having sharp straight edges, to fit Universal Holder 1324J **$0.50**

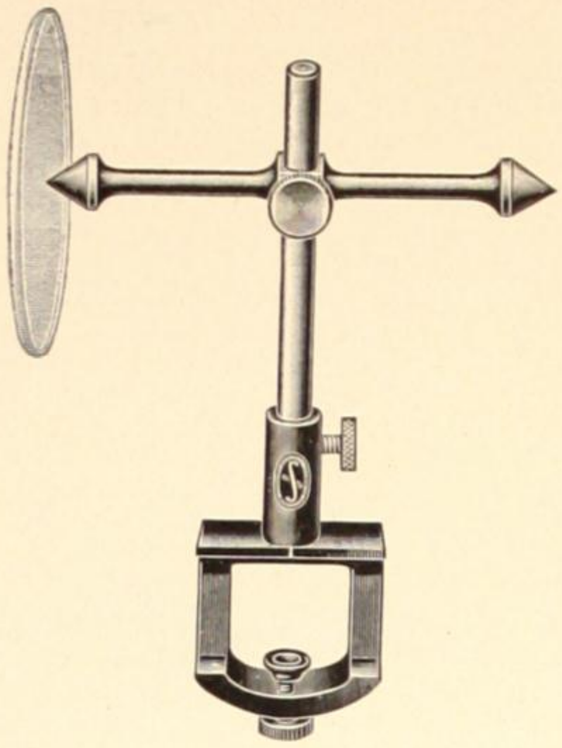
780J. Lenses with Spherical Surfaces, Double Convex; 50 mm. diam., edged and polished:
15 cm. focus **$1.75**
25 cm. focus **1.75**
35 cm. focus **1.75**

785J. Lenses with Spherical Surfaces, Double Concave; 50 mm. diam., edged and polished:
15 cm. focus **$1.75**
25 cm. focus **1.75**

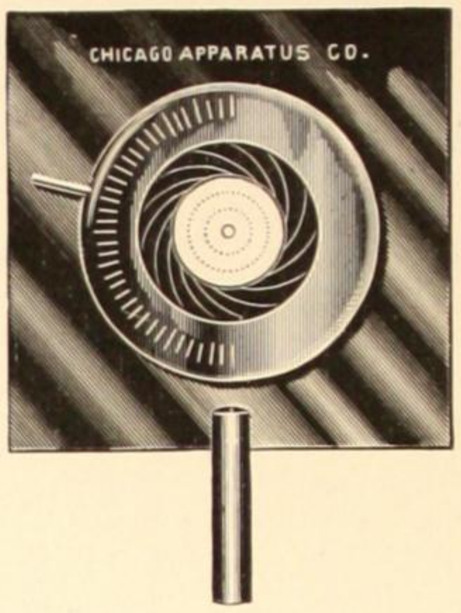
790J. Set of Lenses, for Optical Bench experiments, including: 3 Double Convex Lenses 780J, of 15, 25 and 35 cm. focus, and 2 Double Concave Lenses 785J, of 15 and 25 cm. focus **$8.75**

1340J. Set of Four Pins. One each short and long with black and white heads, mounted to fit 1322J Sliding Clamp. **Per set** **$0.40**

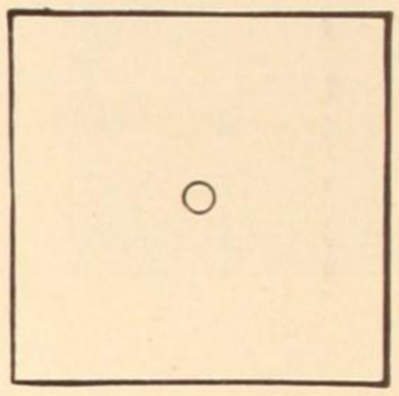
1336J. Farwell-Stifler Nodal Slide Equipment, for determining the equivalent focal lengths and nodal points of a combination of lenses. The desired combination is built up from ordinary lenses held in Universal Holders. The special equipment consists of a short metric bar (about 18 cm. long), 2 special narrow Sliding Clamps for holding the Universal Holders, and 1 special Narrow Clamp for supporting the bar; 2 Elevating Rods are included for lifting the object-screen, etc., to the same height as the Nodal Slide. The whole arrangement is shown in the cut on page 188. The Nodal Slide Equipment also includes the necessary fourth Universal Holder **$6.00**



No. 1350J with No. 1322J.



No. 1352JA.



No. 1352JB.

1350J. Farwell-Stifler Vertex-Pointer, with vertical adjustment, for locating exact position of vertex or pole of lens or mirror. The distance between the conical points of the horizontal bar is exactly 10 cm., so that the horizontal distance between the index mark on the sliding clamp and either end of the crossbar is 5 cm. In order therefore to locate the vertex of the lens or mirror, all that is necessary is to adjust the vertex-pointer until the tip end just touches the optical surface at its center. Add or subtract 5 cm. to the index reading to obtain position of surface vertex. The axial thickness of a lens can be determined by locating in this way the position of the vertices of the two surfaces. Made to fit Sliding Clamp 1322J **$1.50**

1352JA. Diaphragm, Farwell-Stifler, Iris Form. Instantly adjustable to any aperture from 2½ to 30 mm. in diameter. A graduated scale enables resetting to any aperture previously used. More convenient and more rapid than plain diaphragms. Mounted on 3x3 inch metal plate and provided with support rod to fit No. 1322J Sliding Clamp. Finished in optical black **$6.00**

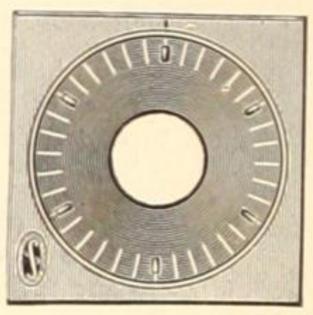
1352JB. Diaphragms, Set of Three. Fit Universal Holder No. 1324J. One each with circular openings of ¼, ½ and ¾ inch. **Per set** **$0.75**

1353J. Cutter, for making circular apertures in cardboard to serve as diaphragms for optical bench **$3.50**

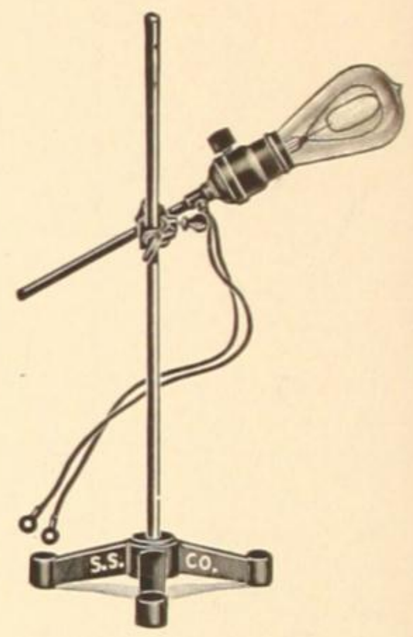
1355J. Farwell-Stifler Lens Rotator, provided with circular graduated scale, for adjusting axis of cylindrical lens in any azimuth. Made to fit the Universal Holder 1324J **$3.00**

795J. Cylindrical Lenses, +3, —3, +5, —5, set of four, for use with Lens Rotator 1355 J. **Set** **$9.00**

700J. Lens Measure. A direct-reading instrument calibrated in the dioptric system, in which the unit is a focal length of one meter (100 cm.). Graduated to —10 and +10 diopters in one-fourth diopter divisions. To determine the focus of a lens it is pressed against the three points, one of which is movable. the pointer indicates, say 10. Dividing 100 cm. by this figure gives 10 cm.—the focal length of the lens in question. Similarly a lens that registers 5 has a 20 cm. focus, etc. Convex lenses register on the plus side and concave lenses on the negative side of the gauge. Provides the easiest, simplest, most rapid and practical means for testing, checking and sorting lenses. (Illustrated on page 200) **$13.50**



No. 1355J.



No. 1360J.

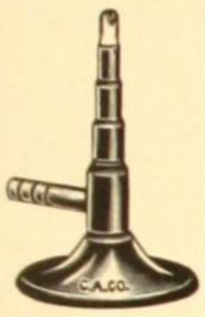
1360J. Lamp Stand, with universal arm and clamp for holding incandescent lamp, and adjusting it to required position for optical bench experiments. Without lamp **$3.50**

1360JA. Carter Lamp Bracket, including Sliding Clamp 1322J to fit meter stick of Optical Bench, including cord and plug **$5.00**

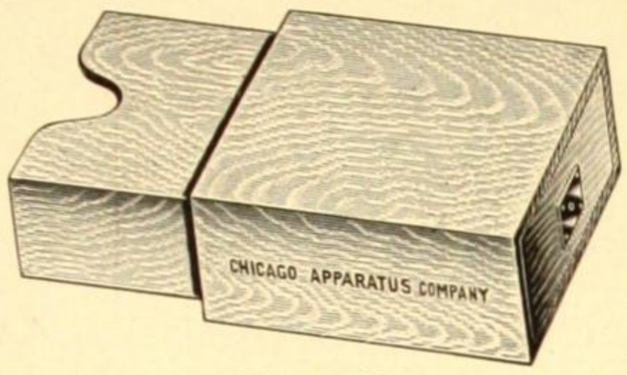
512K. Arc Lamp, with simplified hand feed, complete with rheostat, mounted on stand, provided with focusing arrangement for producing parallel rays. For use on 110-volt circuit **$25.00**

1400J. Farwell-Stifler Smoke Box, for Optical Demonstrations, made to fit over any of the Farwell-Stifler Optical Bench Equipments of one-meter length. An opening is provided at one end for admission of light beam from arc lamp. It is fitted with a movable glass front through which the experiment may be viewed. The Ray Screen 1333J, can be used to advantage to give characteristic ray formations. This smoke box furnishes an excellent method for demonstrating the actual path of the rays in any optical system that may be set up on the bench. To make the rays visible a dense smoke from tough paper or other material is necessary **$20.00**

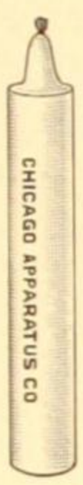
Apparatus for Light—Section K



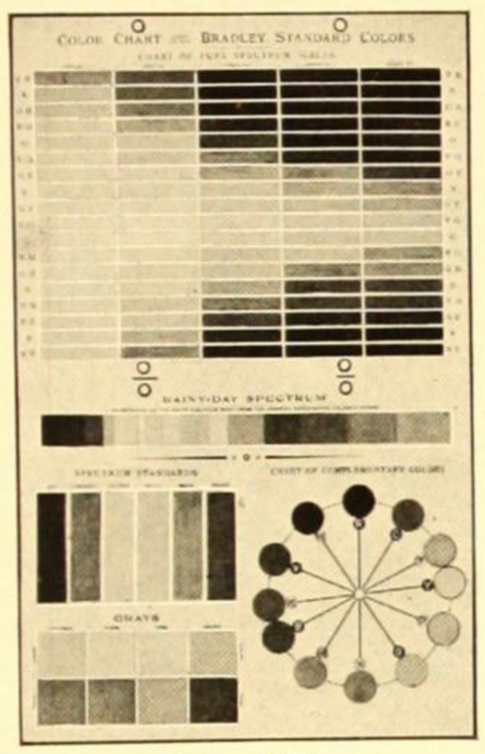
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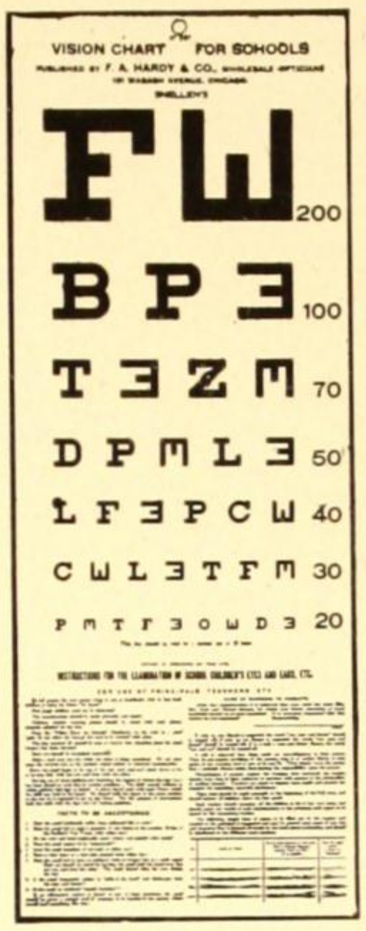
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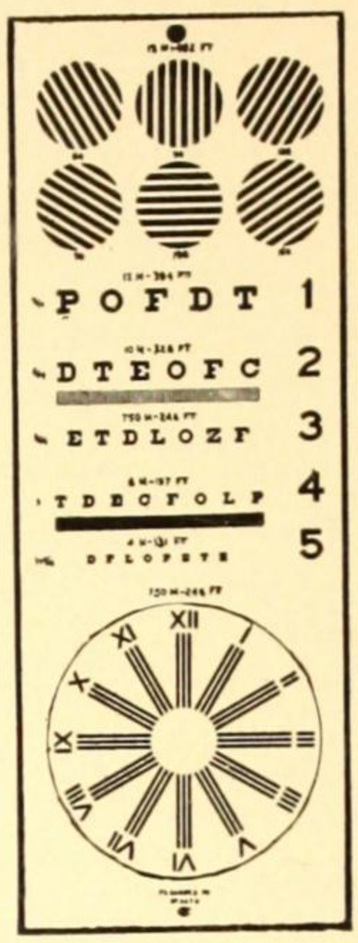
Nos. 27K-37K.



No. 44K.



No. 820B.



No. 830B.

7K. Block, Wood. Size, 7.5x10x2.8 cm.; with millimeter scale along one 10 cm. edge. As used in Millikan, Gale and Bishop's Course in determining the laws of image formation in convex lenses.....**$0.25**

12K. Block, Wood. As used in Black's Course in Studying images in a plane mirror. Wood block, 3x10x2.2 cm., with vertical black line on one face **$0.25**

19K. Burner, Illuminating. Low form, with aluminum gas tip, for use as an illuminant in optical experiments **$0.60**

22K. Camera Obscura or Pin Hole Camera. For student's use in the study of images produced by a small lensless aperture. Consists of two telescoping wood boxes, one with pin hole, the other with a ground glass screen. Size, closed, about 6x12x20 cm. **$2.50**

27K. Candles, Paraffine, Twelves. Length 12.5 cm.; weight per twelve, about 1 lb.; candle power, about 1.25. **Per dozen** **$0.25**

32K. Candles, Paraffine, Sixes. Length, 22.5 cm.; weight per six, about 1 lb.; candle power, about 1.25 **Per dozen** **$0.50**

37K. Candles, Standard. Length, 12.5 cm. When burning, this candle consumes 120 grains (7.776 grams) of wax per hour, yielding one candle power of light, and hence is much used on photometers and optical benches as a standard for comparison. **Each** **$0.40**

42K. Candles, Wax. Colored Christmas candles, about 3¾ inches long by ⅜-inch diameter. In boxes of 36. **Per box** **$0.20**

44K. Chart, Color, Bradley Standard. On heavy white cardboard, hinged at the middle and provided with eyelets for hanging. Size, open—22x13¾ inches, folded—11x13¾ inches. Contains five series of colors:

1. **Spectrum Standards**—six colors; red, orange, yellow, green, blue and violet.
2. **Spectrum Scales**—Ninety colors; eighteen standard colors arranged vertically with two tints to their left and two shades to their right.
3. **Complementary Colors**—Twelve Colors in circular arrangement with the standard colors and their complements opposite each other.
4. **Rainy-Day Spectrum**—A band of six standard colors and ten intermediates showing the relative value of spectrum colors obtained by means of a prism.
5. **Grays**—A series of eight including neutral, warm and cool grays.

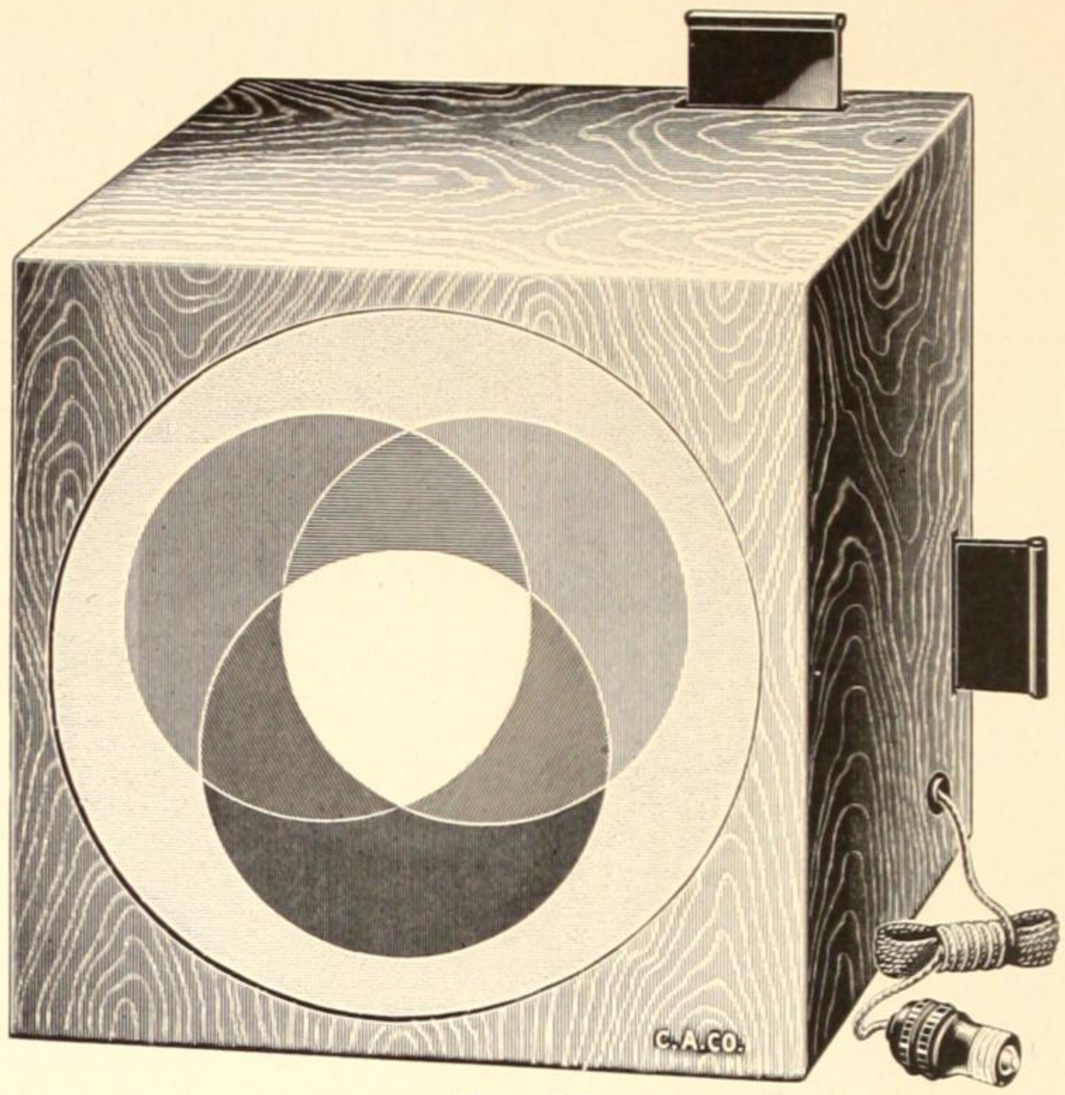
Suggestions for using the five color series together with descriptive text appears on the back of the chart **$2.25**

47K. Spectacles or Eyeglasses. With plus 50 diopter lenses as called for in "Laboratory Problems in Civic Biology," by Hunter **$4.00**

820B. Charts, Eye Test, Allport's. A simple device for testing the eyes of school children. An improved form of Snellen Chart. On heavy bristol board 11x27 inches, with eyelet for hanging.....**$0.75**

830B. Charts, Eye Test, Snellen's. For school use, with astigmatism diagram. On heavy bristol board with eyelet for hanging. Size 10x28 inches....**$0.75**

Singerman's Color Apparatus



No. 50K.

50K. Color Apparatus, Singerman's. (Patent Applied for.) After design by Prof. J. Singerman of the James Monroe High School of New York City. In offering this new instrument we do so with the knowledge that it has given the utmost satisfaction in the lecture rooms of several New York schools privileged to use the original model. It is especially suited for demonstrating all the color phenomena usually presented in high school and college courses —Effects resulting from various combinations of primary colors—Synthesis of white light—Color fatigue —Shadows by colored lights.

With it can be reproduced all the experiments on colored light that are possible with the more expensive Von Nordroff's Apparatus, without any of the inconveniences or disadvantages of the latter. While admittedly, Von Nordroff's Apparatus, once it is set up, gives good results, it has from a teaching standpoint some serious drawbacks. It requires the setting up of a separate projector and a separate screen, operations which are time consuming, troublesome, and distracting to the class. With crowded curricula and short periods, too large a percentage of the time is consumed in making and maintaining the necessary adjustments. It is impossible to transport the entire "set-up" from room to room as is frequently desirable in large crowded schools. Furthermore, because of the foregoing disadvantages, the apparatus is not used as much or as frequently as color study in the present-day courses demand.

Another device commonly used for teaching color combinations is the rotator with revolving color disk. This also has some marked disadvantages from a teaching standpoint. The result produced with this apparatus is not a physical mixture, but an optical illusion. Thus, an additional complexity is injected that must be explained to the class. The colors that appear on the stationary disk are not really the colors that mix. The class, therefore, never sees the exact components which enter into the mixture. The light reflected from each sector must be imagined to spread evenly over the entire disk. Certainly if the light from one sector were spread evenly over 360 degrees, the result would be a very different color sensation from that caused by the sector at rest. Then, too, the colors of the sectors are affected by the color of the light falling upon them. For these reasons the effects produced by color disks are seldom what they should be. For example, instead of white, the resulting color is more often gray. Furthermore, varying the proportions of the component colors is impossible with

"fixed-sector" disks and extremely slow and tedious with the "loose-sector" type. Also, the color disk is not adapted to experiments in color fatigue or the study of shadows produced by colored lights.

Still another method that is sometimes used employs lantern slides with colored films selected and arranged to produce certain predetermined results. In these the relative color values or intensities are fixed, and no variation or alteration from this fixed relationship is possible. Hence, the student is too apt to conclude that, for example the combination of any red, blue or green will produce white, whereas white occurs only when the component colors have the correct values or intensities. That the result may be otherwise, can be explained but cannot however be demonstrated by this method. From a teaching standpoint so-called color mixers, in which the color values or intensities likewise are fixed, also fall short. Furthermore, color slides and color mixers reveal to students a multitude of colors, effects, and results, which while pleasing as a whole, distract from the particular phenomena under discussion.

The Singerman Color Apparatus has none of the afore-mentioned disadvantages, yet with it can be reproduced all the results possible with the different types of equipment referred to—and more. And furthermore, with a convenience, simplicity, and effectiveness never before realized in color demonstration apparatus.

It consists of a cubical wooden box, about 40 cm. on each edge, having a ground glass screen at the front and within which are mounted three Mazda lamp illuminants, three diaphragms, and three color filter holders. Separate outside switches for the lights, separate handles for the diaphragms that project through the sides of the case, and glass filter plates removable through slots, provide complete external control within easy reach of the operator.

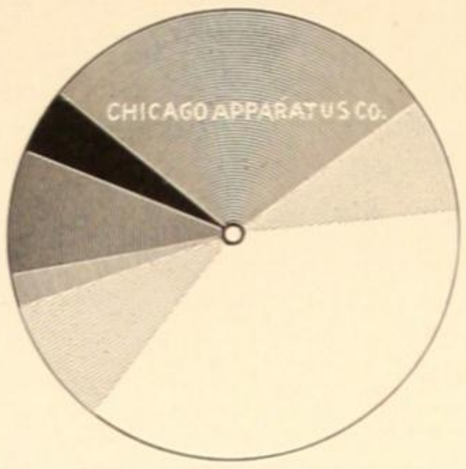
When placed on a lecture table, with its ground glass screen facing the class, its cord connected to a light socket, and three colored filters—red, blue, and green in place, it is ready for use. At the throw of a small tumbler switch, a red circle of light—about 10 inches in diameter—appears on the screen. At the throw of a second switch, a blue circle of light makes its appearance, the overlap resulting from the combination of the two colors being purple. By increasing the intensity of the red light or decreasing the intensity of the blue, which can be done by merely adjusting the corresponding diaphragms, the purple takes on a more reddish hue. Conversely, this purple sector can be made to take on a bluish hue. At the throw of the third switch, a disk of green light overlapping the other two now makes its appearance. If the color intensities are correct, the central sector will be pure white. If it appears reddish, greenish or bluish, it is an indication that the intensity of one of the lights is too great. By adjusting the proper diaphragm, the excess light is quickly removed, giving to the central sector the desired resulting color—pure white. Conversely it can be shown that the central sector assumes the hue of the predominating color in the mixture.

By using the red and green circles of light, it can be shown that the resulting mixture will be yellow, that of the green and blue lights, bluish green; and that of the red and blue lights, purple. By substituting other color filters, the results produced by other combinations can be shown.

To show color fatigue, a circle of light, as for example red, is caused to appear on the screen. The diaphragm is opened wide to provide maximum intensity. After the student has fixed his gaze on this color circle for a while, the light is switched off and if he continues to fix his gaze on the screen, he will perceive a bluish green circle of light—the complement of red. Similarly the fatigue effects produced by other colors can be studied. The shadow effects produced by opaque objects in the path of colored rays can also be shown with equal ease. The hinged rod for producing a shadow on the screen is lowered and one of the color filters is removed. Under this condition a spot of white light and of a colored light appears on the screen, together with the shadow of the rod. If the colored light used is red, the shadow will appear green. If green light is used, the shadow will appear carmine; whereas if blue light is used, the shadow will appear yellow. That the shadows are in reality not colored, but black, may be shown by turning out the white light. The shadow effects are due to subjective colors corresponding to the complements of the colored lights used in producing them. By using other filters, the effects produced by other colors can be investigated.

The above are but a few of the many demonstrations possible with this new apparatus. Others, and variations from the above will suggest themselves to the user once he has become familiar with its performance.

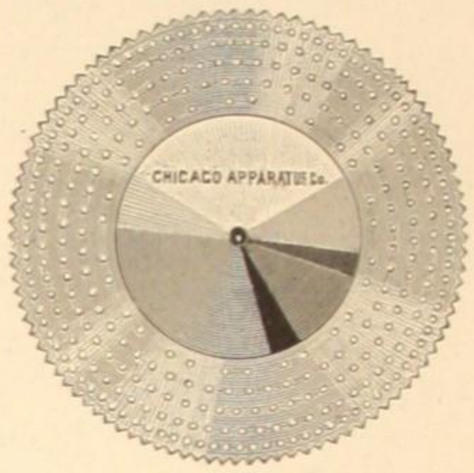
For compactness, simplicity of operation, and ease of storage, transport, and set-up for use, this new self-contained Singerman Color Apparatus has no equal. Complete as illustrated, with seven color filters—one each red, orange, yellow, green, blue, indigo and violet, cord with plug, and three suitable Mazda lamps for use on 110-volts.....**$40.00**



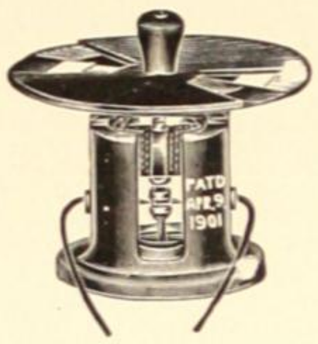
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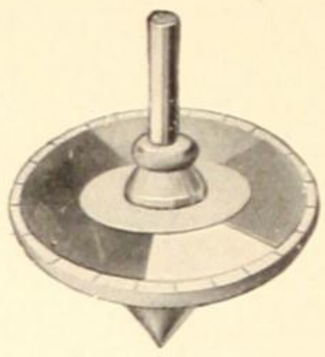
No. 57K.



No. 974R.



No. 313E.



No. 72K.



No. 77K.

52K. Color Disk, Newton's Milvay Improved. The colors on this new improved disk are processed directly on the metal. This method permits washing of the disk when it becomes dirty, likewise there is no peeling of a colored paper surface rendering the disk unfit for use, such as occurs in ordinary forms. Disk is 20 cm. diameter; on one side are the seven primary colors properly proportioned for recomposing white light. On the other side are equal portions of red, yellow, and blue—Brewster's Disk—which appears white or gray on rapid rotation, 6 mm. center hole. Fits any Rotator.....**$1.00**

57K. Color Disks. Four complete groups of color disks for color analysis, recomposition of white light, etc. Sizes 8, 14, 20 and 25 cm. in diameter. Each set contains violet, blue, green, yellow, orange, red, black, white disks and a graduated disk for quantitative color mixing. In neat cardboard box, 6 mm. center holes. Fits any Rotator.....**$4.50**

62K. Color Disks. Two sets, 8 and 14 cm. in diameter; each set contains violet, blue, green, yellow, orange, red, black and white disks. A graduated disk for quantitative work in color mixing which may be used with either set, is included. Illustrated shading, blending, changing of colors, complementary colors, Maxwell's cut color disks. With 6 mm. center holes. Fits any Rotator.....**$1.50**

974R. Color Disk and Siren Disk. Milvay Improved. Metal, 24 cm. in diameter. Has five rows of holes, four evenly spaced and one unevenly spaced; toothed edge and primary colors in proper proportion in center. These colors are processed directly on the metal which permits washing of the disk when it becomes dirty, likewise there is no peeling of a colored paper surface rendering the disk useless, such as occurs in ordinary forms.

Three disks in one—Siren Disk, Savart's Wheel, and Newton's, 6 mm. center hole. Fits any Rotator **$2.00**

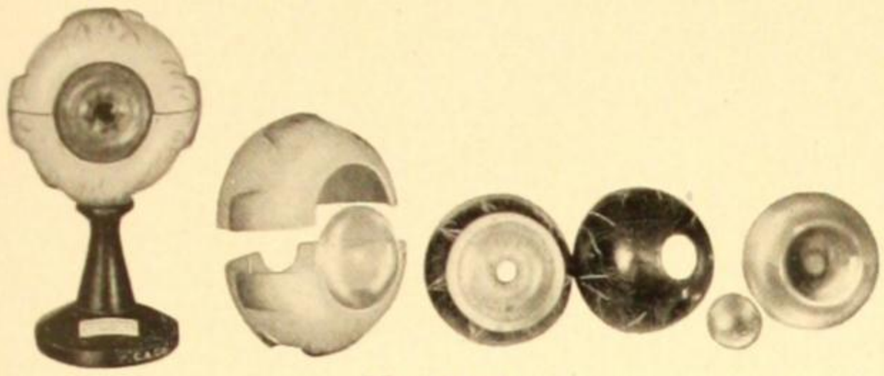
313E. Color Top, Electric. Will run at high speed for hours. Four color disks are furnished. When top is at rest, the current is automatically shut off—no danger to the battery from this cause. It may be used equally well as a motor, and small mechanical toys may be operated by a belt from the grooved pulley on shaft. Runs efficiently on one cell, dry or other battery. Finished in red enamel; polished nickel trimmings **$1.75**

72K. Color Tops. For students' use in the study of colors, their complements, etc. To be spun with the fingers. Complete with eight 19 mm. color disks, eight 38 mm. color disks, and a graduated disk **$0.22**

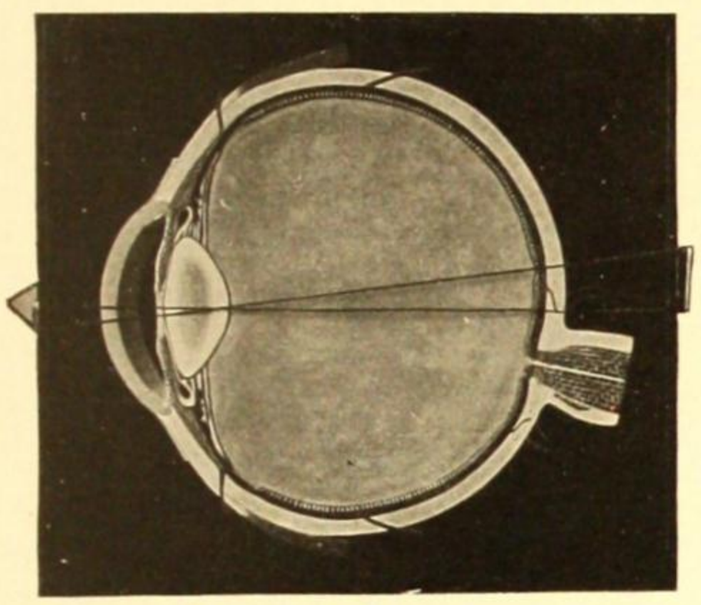
77K. Diffraction Grating Replica. On holding this grating close to the eye one can see a spectrum of any light source which is approximating to a line and which is more than about 6 feet distant. Two spectra are visible, one on each side of the light source, displaced a few degrees from it. The most suitable light sources are straight form spectrum tubes like our Nos. 330F-345F, but flame spectra can be shown by placing the flame behind a screen in which a slit has been cut.

The Fraunhofer lines in the solar spectrum may be seen in the following manner. Take a brightly polished needle and fix it to a large piece of black card. Support this about three feet from the eye in such a manner that the brightest possible reflection of direct sunlight is observable. Now on introducing the grating in front of the eye the solar spectrum will be seen, with the dark lines of the absorption bands crossing it, the convex cylindrical surface of the needle having an effect similar to that of the slit of a spectroscope.

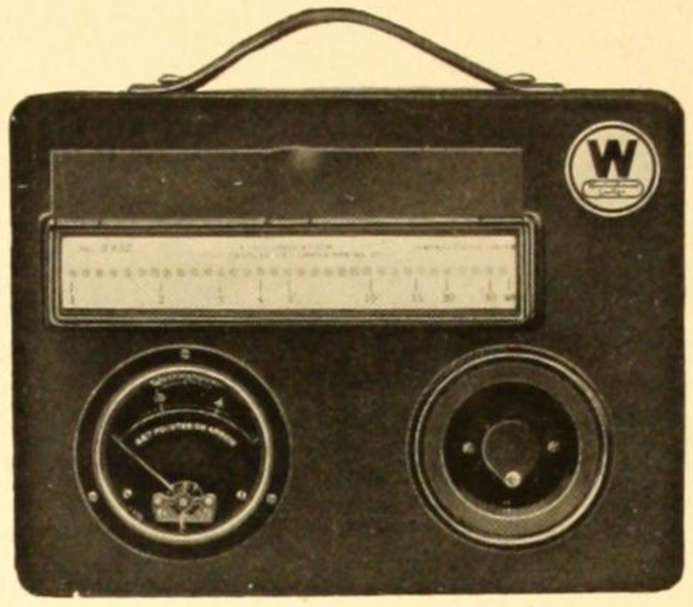
Grating consists of two protective glass plates bound together at their edges and enclosing a transparent replica of about 14,500 lines to the inch, and about 1 sq. cm. in area. Unquestionably the best low-priced grating on the market.....**$2.00**



No. 7514.



No. 7518.



No. 79K.



Nos. 97K-98K.

7514. **Eye Model, Greatly Enlarged Model of the Right Eyeball.** The upper half lifts off, exposing the vitreous body. It is hollowed in front to receive the crystalline lens. The vitreous body and lens are removable, as is also the concave convex cornea with the blue iris. The inner surface of the removable upper portion shows a section of retina with its various layers greatly magnified. The optic nerve with its central artery is shown as it enters the interior of the eye. The terminations of the six muscles which move the eyeball are clearly shown in the external view. The model not only illustrates all the anatomical structures of the eye, but is also an ideal help for explaining the causes of the various kinds of eye strain, and how to avoid them....**$9.00**

7518. **Horizontal Cut Through the Right Eyeball.** The model is very neatly mounted on a wood plaque and is recommended to present a comprehensive study of the eye. On this model are distinguished the Polus anterior and posterior, the eye axle, the line of collimation. The blood vessels and nerves which supply the inner eye. The muscles of the eye and twenty-five various organs which are clearly defined with the aid of the descriptive key which accompanies this model **$8.00**

79K. **Foot Candle Meter.** For measuring directly the foot candles of illumination on any surface. Operates on the Bunsen Photometer principle. A light inside and illumination outside shine on opposite sides of a strip having a series of transparent circles on it and the position of the circle the transparency of which disappears indicates directly on a scale on the front of the instrument the foot candles of illumination. The light inside is operated by a small battery and is regulated and controlled by a small Rheostat and Voltmeter. The complete outfit is mounted in a neat metal case, about 20x25 cm., with handle. A portable device, useful in teaching the commercial application of a Photometer. With instructions **$35.00**

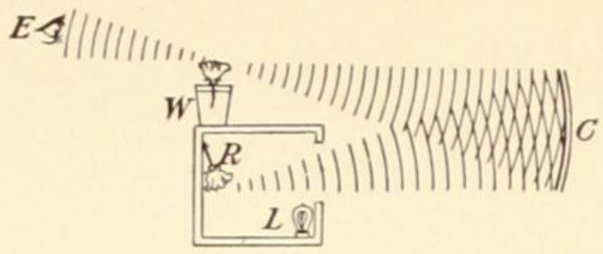
82K. **Glass Plates, Colored.** 10 cm. square, best pot glass.

Cat No.	82K	83K	84K	85K	86K	87K	88K
Color	Violet	Indigo	Blue	Green	Yellow	Orange	Red
Each	**$0.20**	**.20**	**.20**	**.20**	**.20**	**.20**	**.20**

92K. **Glass Plates, Colored.** Set of seven, one each Nos. 82K to 88K. **Per set**.....**$1.35**

97K. **Iceland Spar.** For showing the action of Iceland spar upon light known as double refraction. Medium quality **$0.30**

98K. **Iceland Spar.** Best quality, extra large selected specimen **$0.75**



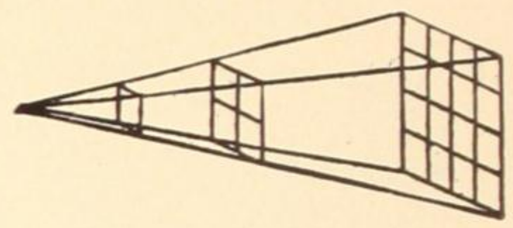
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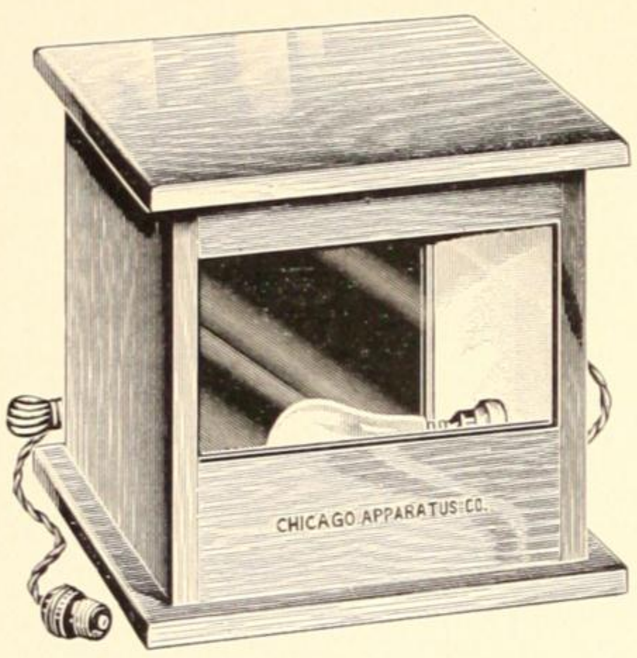
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No. 102K.



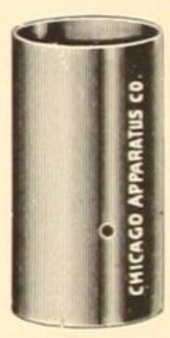
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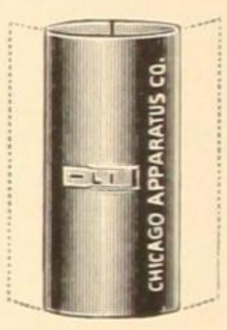
No. 99K.



No. 122K.



No. 127K.



No. 132K.

99K. Image Box. For showing how a concave mirror produces a real image in space. In use, a rose or other flower is suspended from the hook at the back center of the cover. A glass of water is then placed on the top in a position directly over the flower. The lamp is then lighted and a concave mirror (one of either our Nos. 326H or 331H) placed in front of the box and at a distance equal to its radius from the rose. Sighting (from a point a short distance behind the box) across the tumbler towards the center of the mirror the rose will appear to be upright in the water. The inside of the box, except at the back, is finished in matte white to produce proper diffusion, while a 60-watt frosted bulb is provided to supply the required strong illumination. The inside back wall is dead black, to provide a dark space background for the suspended flower or other object. Box measures 25 cm. high, 25 cm. deep and 20 cm. wide, and the window covered by glass 12.5x20 cm. Complete, with one 60-watt, 110-volt frosted lamp, 5-foot cord and plug, but without mirror or object.....**$12.50**

100K. Interference Plates. Two pieces of plate glass about 100x13 mm. for showing interference bands, as described on page 405 of Millikan and Gale's "A First Course in Physics".....**$0.50**

102K. Interference Rings, Newton's. A pair of lenses, 3.75 cm. in diameter, one plane, the other plano-convex, mounted in a metal frame, with three compression screws which also act as legs. The plano-convex lens, when under compression, shows a series of spectrum-colored concentric circles, which are due to the interference of the light waves...**$2.25**

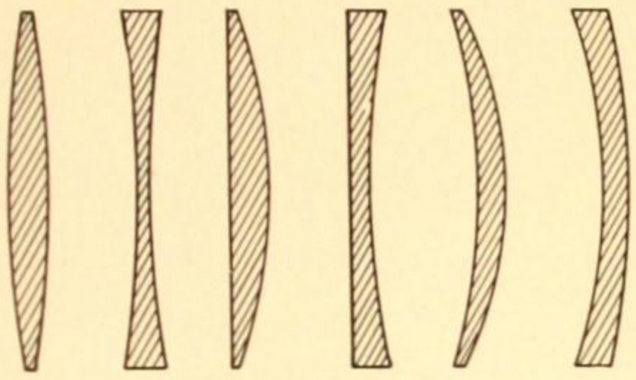
112K. Inverse Squares Frame. For explaining the decrease of intensity of light with distance according to the law of inverse squares. Consists of four wires diverging from a point and to which are attached at uniform distances three frames whose areas are 1, 4 and 9 units square. Length, 22.5 cm.....**$1.75**

122K. Lamp, Kerosene. Brass, with wick 1 cm. wide. For use as a source of light. Height overall about 14 cm. Including wick and chimney.....**$0.45**

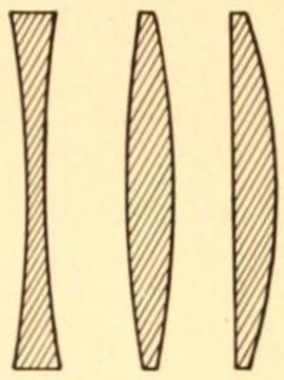
127K. Lamp Shade. A metal cylinder with a small hole in it. When placed over the chimney of No. 122K Lamp, it provides a narrow beam of light.**$0.35**

132K. Lamp Shade. As used in Linebarger's Course in determining the focal length of convex lenses, and in studying the characteristics of the images formed by them. Consists of a 15x40 cm. blackened metal cylinder with a small hole in it, and in front of which is mounted a movable slide having three slits—vertical, horizontal and L-shaped. Placed over a lighted lamp or burner it furnishes a beam of light the shape of which depends upon the slit used.....**$2.00**

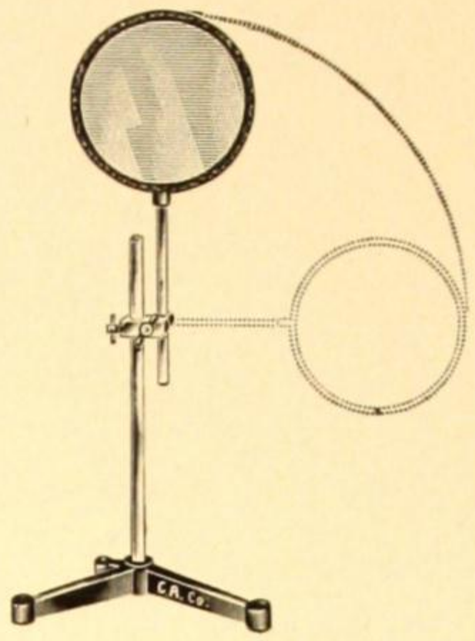
LENSES



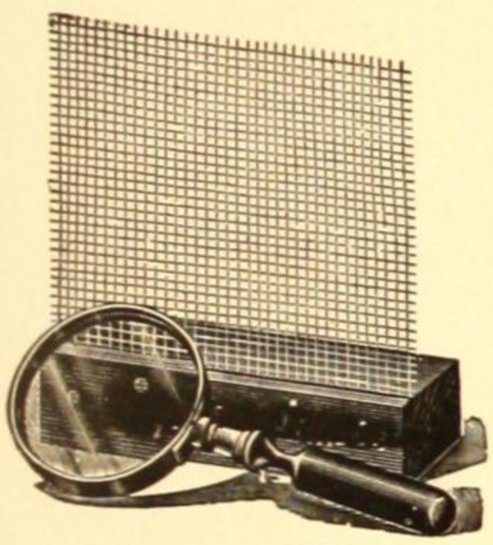
Nos. 137K-147K.



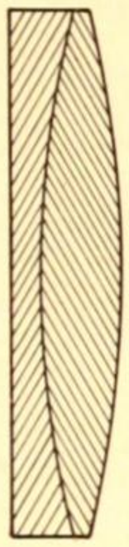
Nos. 152K-162K-192K.



Nos. 201K-202K.



No. 207K.



No. 209K.



No. 210K.



No. 2035B.

137K. Lenses, Demonstration Set. Six lenses, with ground edges—one each double convex, double concave, plano-convex, plano-concave, convexo-concave, concavo-convex—each 3.75 cm. in diameter....**$2.00**

142K. Lenses, Demonstration Set. Same as above, but 5 cm. in diameter and of better quality.....**$3.25**

147K. Lenses, Demonstration Set. Set of ten lenses, with ground edges, consisting of—cylindrical convex, cylindrical concave, sphero-cylindrical and sphero-prismatic, in addition to the six lenses of Set No. 137K **$6.00**

152K. Lenses, Double Concave. Ground edges, first quality.

Cat. No.	152K	153K	154K	155K	156K	157K
Diameter, cm.	3.75	3.75	3.75	5	5	7.5
Focus, cm.	10	15	20	15	20	20
Each	**$0.50**	**.50**	**.50**	**.65**	**.70**	**1.50**

162K. Lenses, Double Convex. Ground edges, first quality.

Cat. No.	162K	163K	164K	165K	166K	167K
Diameter, cm.	3.75	3.75	3.75	3.75	3.75	3.75
Focus, cm.	5	10	15	20	30	37.5
Each	**$0.50**	**.30**	**.35**	**.30**	**.30**	**.40**
Cat. No.	168K	169K	170K	171K	172K	173K	174K
Diam., cm.	5	5	7.5	10	10	12.5	15
Focus, cm.	12.5	50	17.5	25	50	35	100
Each	**$0.40**	**.40**	**.75**	**1.50**	**1.50**	**2.75**	**3.00**

182K. Lenses, Double Convex. Second quality.

Cat. No.	182K	183K	184K	185K
Diameter, cm.	3	3.75	3.75	3.75
Focus, cm.	5	10	15	20
Each	**$0.40**	**.40**	**.30**	**.30**

192K. Lenses, Plano-Convex. Condensing lenses, as used in projection lanterns.

Cat. No.	192K	193K	194K	195K	196K
Diameter, inches	4	4½	4½	4½	5
Focus, inches	7	6½	7½	10	9
Each	**$1.25**	**1.25**	**1.25**	**1.25**	**1.80**

201K. Lens, Double Convex, Mounted. Diameter of lens 12.5 cm., focus 35 cm. Lens may be raised from 30 to 50 cm. above table top, and being attached to upright by a swivel clamp, can be set at any angle **$8.00**

202K. Lens, Plano-Convex, Mounted. Diameter of lens 5 inches, focus 9 inches. Mounted on an adjustable stand the same as No. 201K.....**$7.00**

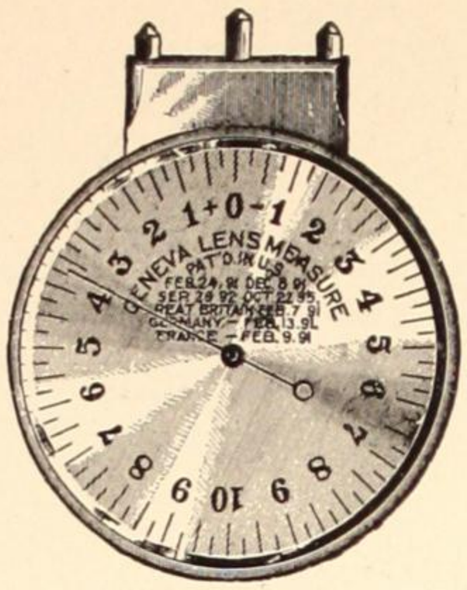
207K. Lens and Screen. As used in Millikan, Gale and Bishop's Course. A 10x10 cm. wire screen mounted on a wooden base; and a 50 mm. double convex lens of about 15 cm. focus in metal frame with handle (reading glass).....**$1.35**

209K. Lens, Achromatic. A plano-concave flint glass lens and a double convex crown glass lens, perfectly fitted and accurately ground. Diameter, 5 cm.; focus 20 cm. **$3.25**

210K. Lens, Fresnel's. For showing the construction and principle of lenses used in light-house lights, semaphores, etc. A cast lens, 7.5 cm. in diameter, one face of which is a series of circular prisms.**$0.35**

2035B. Lenses, Reading Glass. Accurately ground, highly polished, and mounted in nickel-plated rims with ebonized handles. Can be clamped to laboratory supports for use as mounted lenses.

Diameter, cm.	5	6.5	7.5	10
Focus, cm.	12.5	15	17.5	25
Each	**$0.75**	**.90**	**1.15**	**1.75**



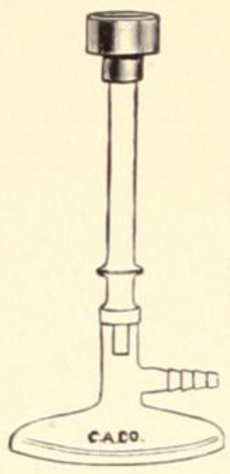
No. 700J.



No. 213K.



No. 214K.



No. 215K.



No. 1990B.

700J. Lens Measure. A direct-reading instrument calibrated in the dioptric system, in which the unit is a focal length of one meter (100 cm.). Graduated to —10 and +10 diopters in one-fourth diopter divisions. To determine the focus of a lens it is pressed against the three points, one of which is movable. The pointer indicates, say 10. Dividing 100 cm. by this figure gives 10 cm.—the focal lengths of the lens in question. Similarly a lens that registers 5 has a 20 cm. focus, etc. Convex lenses register on the plus side and concave lenses on the negative side of the gauge. Provides the easiest, simplest, most rapid and practical means for testing, checking and sorting lenses **$13.50**

212K. Lens Paper. A special grade of soft bibulous paper for cleaning lenses. Size, 17.5x30 cm. Per package of 100 sheets..... **$0.60**

213K. Lens Paper in Books. Same as No. 212K except in books of 50 sheets 4x5½ inches. As each sheet is perforated it is easy to remove it from the book. **Per book** **$0.15**

214K. Light Ray Board, Brownlee's. For use in reflection and refraction of light ray experiments. When a strong light (Sun light; beam from an illuminator, lantern, or other source) is caused to fall through the slit it traces a narrow ray path across the page of a note-book placed on the base back of it. By placing a mirror or the lenses and prisms from an optical disk outfit on the note-book page the paths of the incident, reflected, and refracted rays can be traced and marked by the student for his record of the experiment. The metal plate with slit is attached to a heavy 20x25 cm. wooden base, and both are finished in optical black. Reference—Exp. 40, "Laboratory Exercises," by Fuller, Brownlee and Baker (1927) **$1.75**

215K. Monochromatic Flame Attachment for Bunsen Burners. Consists of a small reservoir with an asbestos wick at its center and designed to slip over the top of the burner. When in place the wick surrounds the mouth of the burner closely and feeds up to the flame any solution placed in the reservoir. In this way the salt in the solution continuously colors the flame with its characteristic color. Since only a small amount of the dissolved salt is consumed, frequent renewals are not required, it being necessary only to replace the water as it evaporates. Fits any burner with $\frac{7}{16}$ inch tube.
Without burner **$1.25**

216K. Monochromatic Flame Burner. After Zeleny and Erikson. For coloring a flame by holding a small amount of salt over its tip. Consists of a Chromel wire holder attached to the body tube of a No. 426C Milvay Bunsen Burner.
Including burner **$0.75**

1990B. Linen Tester. As used in Millikan, Gale and Bishop's Course for finding the magnifying power of a simple lens. Folding brass mount, 6x6 mm. aperture **$0.50**

227K. Microscope Tube and Scale. As used in Millikan, Gale and Bishop's Course, in connection with linen testers, in studying the principle of the compound microscope, and in determining the magnifying power of a convex lens. Consists of a blackened metal tube, 2.5x12.5 cm., with one-hole cork in each end; and 30 cm. wood scale graduated in millimeters **$0.40**

MIRRORS



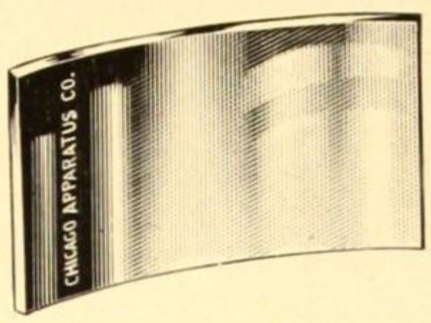
Nos. 40J-45J.



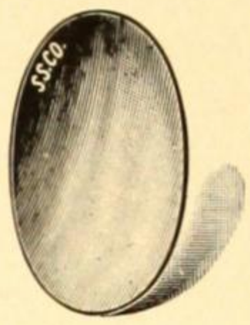
No. 46J.



Nos. 232K-237K.



No. 242K.



No. 247K.



No. 252K.



No. 437K.



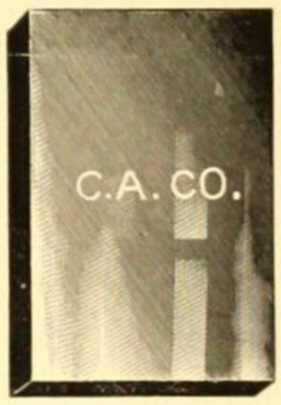
No. 257K.



No. 259K.



No. 262K.



No. 267K.



No. 272K (in use).

40J. Mirror, Concave, Glass, with Aluminum Protecting Back. High-grade optical quality, 80 mm. diameter, 80 cm. focus **$2.00**

45J. Mirror, Concave, with Aluminum Protecting Back. High-grade optical quality, 80 mm. diameter, 15 cm. focus **$2.00**

46J. Mirror, Convex, with Aluminum Protecting Back. High-grade optical quality, 80 mm. diameter, 15 cm. focus **$2.00**

232K. Mirror, Concave. Glass, diameter 4 cm., focus 25 cm. **$1.00**

237K. Mirror, Convex. Glass, diameter 4 cm., focus 25 cm. **$1.00**

242K. Mirror, Concave and Convex. Cylindrical. Brass, heavily nickel-plated and highly polished, 50x72 mm. **$0.60**

247K. Mirror, Concave and Convex. Spherical. Brass, heavily nickel-plated and highly polished, 7.5 cm. diameter, 20 cm. focus **$0.35**

252K. Mirror, Concave and Convex. Spherical. Glass, 12 cm. in diameter, 25 to 30 cm. focus, silvered backs. Mounted in wood frame with handle.. **$2.50**

437K. Mirror, Spherical, Concave and Convex. Same as No. 252K, but mounted on a 10 mm. diameter blackened rod to fit No. 407K Optical Bench Sliding Clamp **$3.25**

257K. Mirror, Plane. Glass, 7.5x5 cm., back painted black so that the light is reflected from the front surface only, thus obviating errors due to refraction **$0.15**

259K. Mirror, Plane. Glass, 4x15 cm., silvered back **$0.15**

260K. Glass, Clear. A piece of plane clear glass, 5x15 cm., for use in reflection experiments **$0.10**

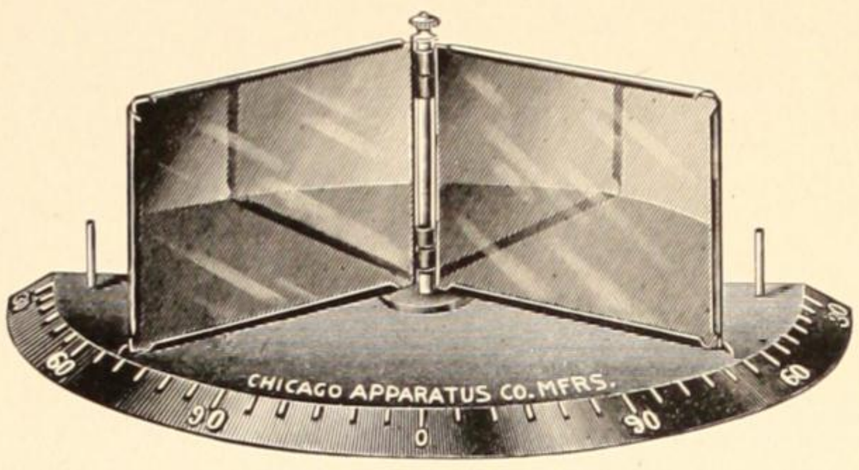
262K. Mirror, Plane. Glass, silvered back, 10x10 cm. **$0.15**

267K. Mirror, Plane. Plate glass, 4 to 6 mm. thick. 10x15 cm. For showing multiple image produced by reflections from the unsilvered front face and silvered back of a thick mirror **$0.40**

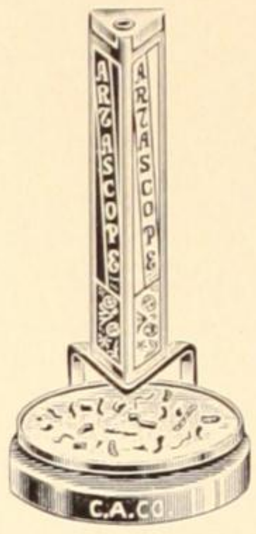
272K. Mirror Support. For holding No. 259K Mirror in a vertical position. Made of spring brass. Without mirror **$0.15**



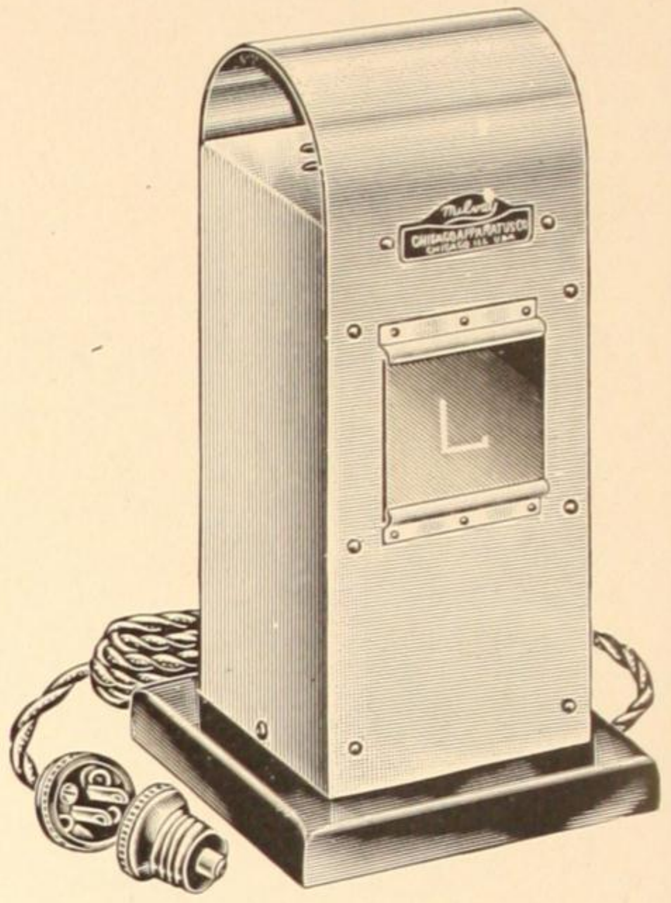
No. 282K.



No. 287K.



No. 288K.



No. 289K.

282K. Multiple Image Apparatus. Simple form. Two 10x15 cm. hinged mirrors. By standing the mirrors on a table and varying the angle between them, the relation between the angle and the number of images can be shown $1.50

287K. Multiple Image Apparatus. Two 10x15 cm. mirrors, in metal back, hinged so that they can be readily set at any desired angle. Mounted on graduated metal base 35 cm. in diameter. For showing the number of images formed in two mirrors at different angles $6.00

288K. Multiple Image Apparatus or Artascope. From an instructional standpoint the Kaleidoscope, which this new device replaces, lacked in two particulars—mirrors and objects were entirely inclosed and therefore the angle of the mirrors could not be revealed and measured, nor could the assortment of objects be changed. By the ingenious construction of this new instrument the principles and effects of multiple reflections can be demonstrated in a most striking and interesting manner. In use scraps of tinted paper—odds and ends of colored crayons—a few colored glass beads—a few brass and aluminum turnings—a paper clip or two, or bits of colored cloth are placed on the revolving platform under the lens. And, before the operator's eyes appears a beautiful, colorful, multiple image, the pattern or design of which changes instantly at a finger touch on the revolving table. Again a slight rearrangement of the objects results in a new image the appearance of which can be further varied by revolving the table. No two effects are ever the same. Substantially constructed of metal, hard to break, never wears out, and beautifully finished. Mirrors are partially exposed so that the angle between them can be measured. Height 9½ inches $2.00

289K. Milvay Optical Light Box. Has many advantages over the candle and non-planary filament lamps so widely used as objects in optical experiments. The flicker and thickness of a candle flame makes it impossible to focus it into a sharp image. As the candle burns away the position of the flame is lowered, necessitating adjustment of the optical system.

The use of an incandescent lamp as an object is unsatisfactory as the filaments of the lamp do not lie in one plane. Only one filament of the lamp can be focused sharply, the other filaments appearing in the image badly out of focus. The position and size of both the candle flame and the incandescent lamp can only be roughly approximated, making it impossible to secure accurate results in experiments involving object and image distances and object and image sizes.

In the MILVAY optical light box with its luminous objects ("L" and "slit"), the disadvantages of the candle or incandescent lamp, as enumerated above, are dispensed with. The luminosity of the object is intense and does not vary. There is no glare, because of the ground glass screen inserted between the source of light (40 watt Mazda lamp) and object slit, therefore, the images can be sharply focused. The height of the object from its base does not vary, eliminating adjustment. The size of the objects does not change and can be accurately measured, permitting accurate comparison of object and image sizes. The objects ("L" and "slit") are planary—every point in them lying in the same plane. This permits accurate determination of the object position, insuring accurate results in experiments involving object and image distances.

Uses

A few of the many uses to which the MILVAY Optical Light Box can be put are the following: Real image formed by a converging lens; Refraction through a prism; Rectilinear propagation of light; Class demonstration of double refraction through Iceland spar; Experimental illustration of law of position of image in a plane mirror; Multiple images from an ordinary mirror; Focal length of a concave mirror and many others.

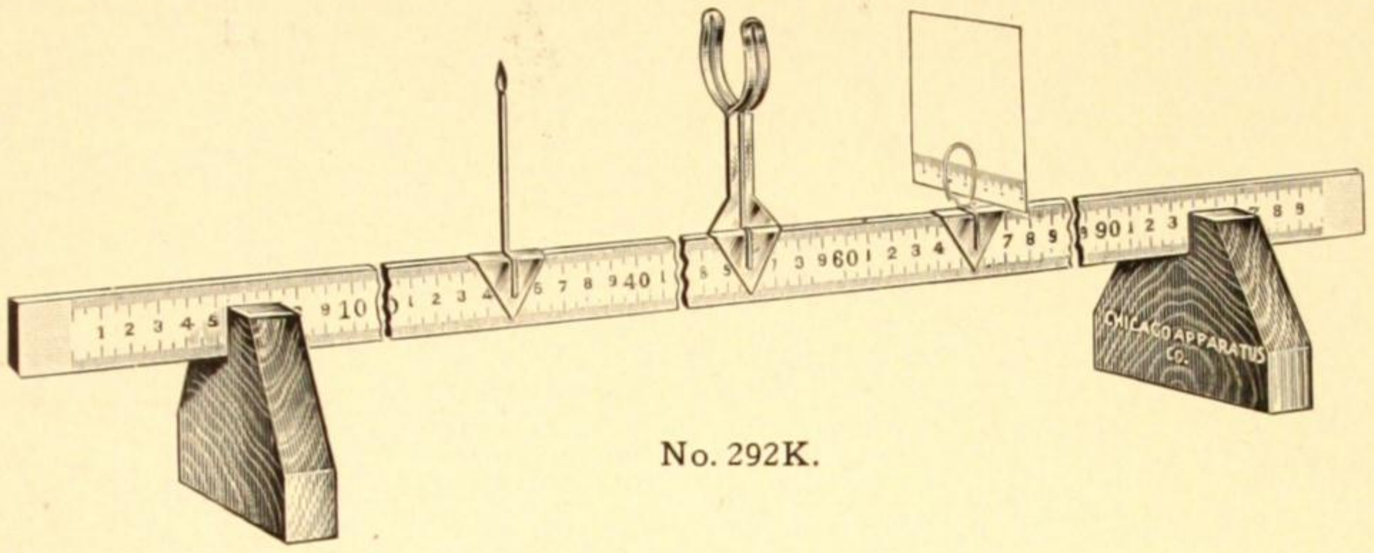
Construction

Body: Aluminum, ventilated, light in weight, insuring against top-heaviness. The body may be easily removed for replacement of lamp. Overall height, 27 cm., base of wood, black finish, 14x14 cm.

Object Plates: Black—two pairs—one pair with "L" figure—one pair with 2 cm. by 2 mm. "slit." The plates are square so that the object ("L" or "slit") may be used in either a vertical or horizontal position. Plates are on two sides (opposite) of light box, so that, if desired, the box may be used simultaneously by two students performing experiments independent of each other.

Illuminant: The MILVAY Optical Light Box is furnished complete with a 40-watt mazda lamp for use on either 110-volt A.C. or D.C. current, and with a 5-foot cord and two-piece separable plug that fits all types of sockets $8.00

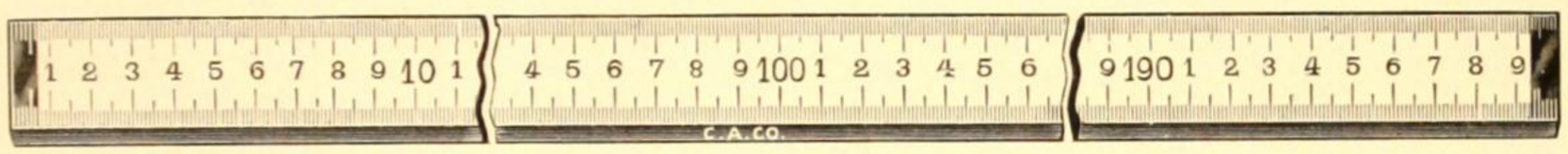
Optical Benches and Optical Bench Parts



No. 292K.



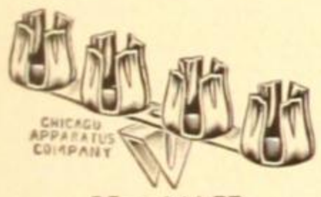
No. 358M.



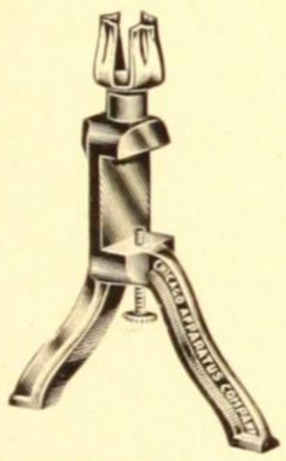
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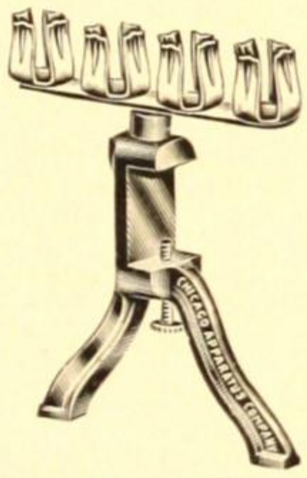
No. 302K.



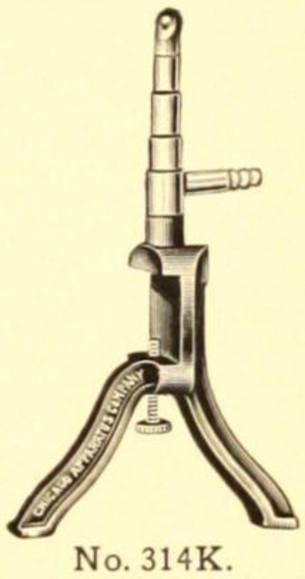
No. 307K.



No. 309K.



No. 310K.



No. 314K.



No. 317K.

292K. Optical Bench. Elementary. Consists of No. 358M Meter Stick, No. 378K Supports, No. 322K Lens Support, No. 337K Pin Support, No. 342K Screen and No. 367K Screen Support.....**$1.00**

297K. Optical Bench. Elementary. Same as No. 292K, but with No. 372K Metal Supports in place of No. 378K Supports **$1.35**

358M. Meter Stick, Maple, One Meter Long. Standard size—25 mm. wide x 8 mm. thick. One side graduated in millimeters, centimeters, and decimeters along both edges; the other side in inches and eights **$0.35**

363M. Meter Stick, Maple, One Meter Long. Same as No. 358M, but ends tipped with brass.....**$0.65**

364M. Meter Stick, Maple, Two Meters Long. A one-piece stick (not two pieces joined together) reading from 0 to 200 cm. on one side and 0 to 78⅝ inches on the other. Graduations, width and thickness same as No. 358M. Brass-tipped.....**$2.00**

302K. Candle Holder. Single. Of metal. To slide on meter stick. For holding a single small candle in a vertical position **$0.12**

307K. Candle Holder. Quadruple. Same as No. 302K, but for four candles.....**$0.35**

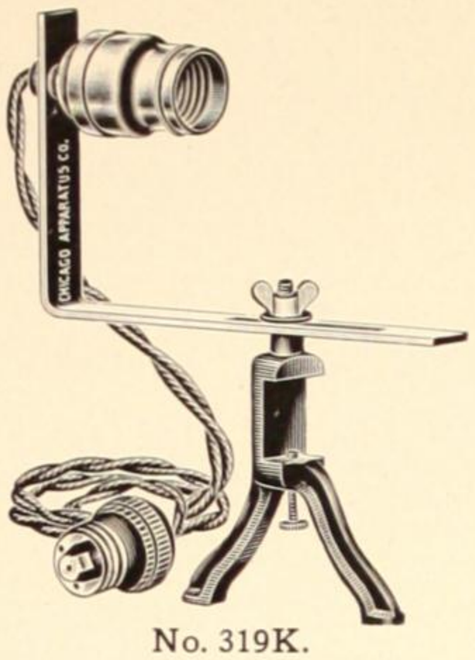
309K. Candle Holder on Support, Single. Consists of holder for one candle mounted on a metal meter stick support. The holder is an improved type that will hold securely either large or small candles in a true vertical position **$0.50**

310K. Candle Holder on Support, Quadruple. Consists of holder for four candles mounted on a metal meter stick support. The holders are an improved type that will hold securely either large or small candles in a true vertical position.....**$0.90**

312K. Gas Burner. Consists of a standard gas pillar with aluminum tip, mounted to slide on meter stick **$0.75**

314K. Gas Burner on Support. Standard gas pillar with aluminum tip mounted on a metal meter stick support **$1.00**

317K. Lamp Socket. For No. 678E Miniature Incandescent Lamps. Mounted on metal support, to slide on meter stick **$0.75**



No. 319K.



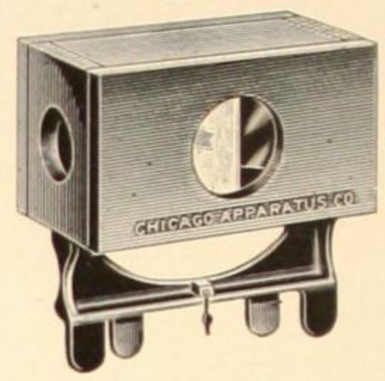
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No. 322K.



No. 327K.



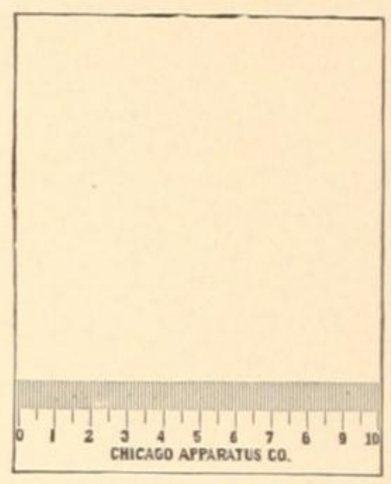
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No. 337K.



No. 347K.



No. 342K.



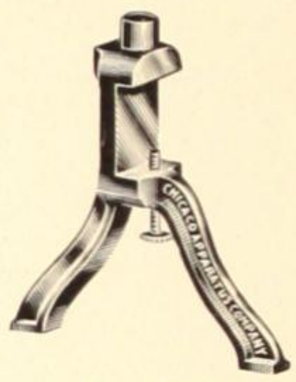
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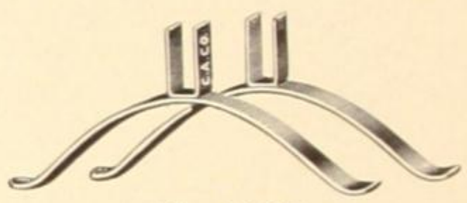
No. 364K.



No. 367K.



No. 372K.



No. 378K.

319K. Lamp Socket on Support. Consists of a standard Edison lamp socket mounted on a metal meter stick support. The mounting is adjustable, enabling either the tip or horizontal candle power to be determined when this device is used in connection with a photometer box. Complete with cord and plug, but without lamp.....**$2.75**

320K. Lamp Support or Platform. For supporting No. 19K Illuminating Burner or No. 122K Small Kerosene Lamp on an optical bench. Top has retaining edge and is 3 inches in diameter. Made entirely of metal with index-type bracket to slide on meter stick **$0.50**

322K. Lens Support. Of metal, to slide on meter stick. For lenses and mirrors about 4 cm. in diameter **$0.12**

327K. Lens Support. Same as No. 322K, but for lenses and mirrors about 7.5 cm. in diameter..**$0.15**

332K. Photometer Box, Bunsen, Easy-Sliding. Designed to slide along a meter stick. (For complete description see No. 527K) **$2.50**

333K. Photometer Box, Joly, Easy-Sliding. Designed to slide along a meter stick. (For illustration and complete description see No. 528K).....**$4.50**

334K. Paraffine Cubes. For use in Joly photometer experiments, 50 mm. on each edge.....**Each $0.50**

337K. Object and Marker. Of metal, to slide on meter stick. Takes the place of old style pin support.**$0.12**

342K. Screen, Graduated. Bristol board, 10x12.5 cm., with millimeter scale along one 12.5 cm. edge..**$0.10**

347K. Screen, Bunsen. Dibdin's modified form in which light passes through a thin paper star instead of grease spot. Bristol board, size 10x10 cm...**$0.25**

352K. Screen, Black's. Bristol board, 10x10 cm., with aperture in center covered with wire gauze.....**$0.25**

353K. Screen, Fuller and Brownlee's. Opaque screen with translucent window having ink lines across at right angles and ink mark in one of the four spaces. Size, 10x12.5 cm.....**$0.25**

354K. Screen, Ground Glass. Size 10x10 cm..... **0.10**

357K. Screen, With One Slit. Black metal disk, 40 mm. diameter, with 8x1 mm. slit. For support see No. 322K **$0.25**

362K. Screen, With Two Slits. Same as No. 357K, but with two 8x1 mm. slits. For support see No. 322K **$0.35**

363K. Screen, Wire Gauze, Dull's. For use in magnifying power of lens experiments. Size, 10x10 cm.; with 1x1 cm. aperture.....**$0.15**

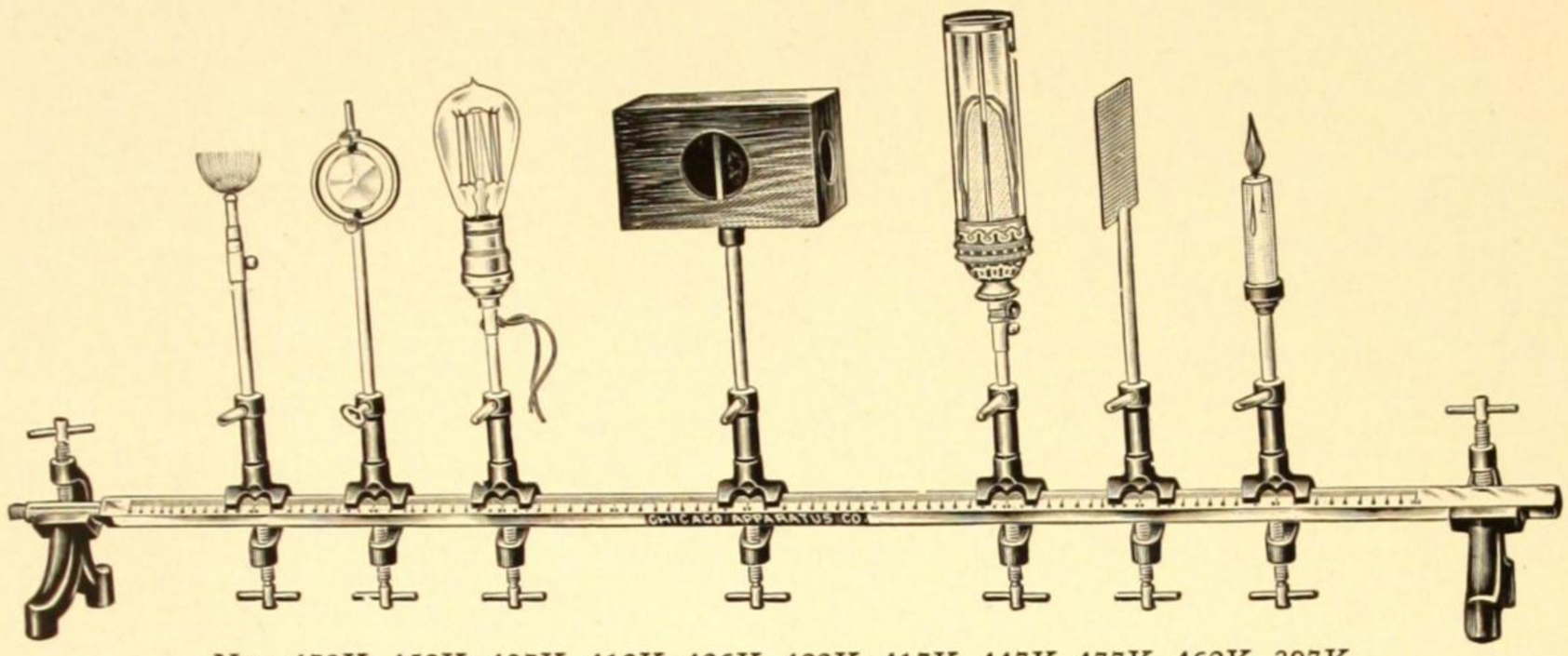
364K. Screen, Object, Wire Gauze, 10x10 cm., for use in front of light source as an object.....**$0.10**

367K. Screen Support. New form, does not bend the screen. Of metal, to slide on meter stick. For holding cardboard and wire gauze screens in a vertical position **$0.10**

372K. Supports, Meter Stick, Metal. A pair of these supports clamped to a meter stick makes an ideal bench for elementary work in optics. More stable than wood supports. Positions of screens, lens, etc., may be changed without danger of overturning the bench .....**Per pair $0.60**

378K. Supports, Meter Stick, Metal. Simple form for supporting meter stick in horizontal position. **Per pair** **$0.25**

Advanced Laboratory Optical Benches



Nos. 472K, 452K, 407K, 412K, 426K, 422K, 417K, 447K, 477K, 462K, 397K.

387K. Optical Bench. Consists of one No. 452K Graduated Rod 1 meter long, two No. 472K End Supports, one No. 426K Lens Holder, one No. 442K Object, one No. 457K Screen Holder and three No. 424K Clamps **$21.50**

392K. Optical Bench. Same as No. 387K, but with ungraduated rod No. 174T..... **$14.25**

Advanced Optical Bench Parts and Accessories

Rods, End Supports, and Clamps

174T. Rod, Ungraduated. 19x19 mm. square nickel-plated steel rod with 6.5 cm. round section at one end. For use in assembling optical benches. Length, 120 cm. **$5.00**

175T. Rod, Ungraduated. Same as No. 174T, but 220 cm. long **$8.25**

452K. Rod, Graduated. Same as No. 174T, but graduated for 100 cm. in mm., each cm. being numbered **$12.75**

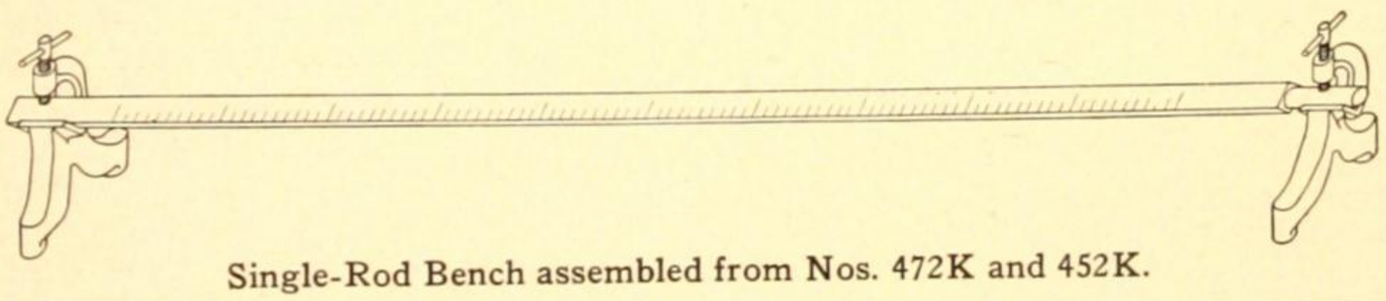
453K. Rod, Graduated. Same as No. 175T, but graduated for 200 cm. in mm., each cm. being numbered **$18.00**

472K. Supports, End, Single-Rod Type. Two will support a 19 mm. square rod parallel to a table top as required in optical bench and photometry work. Of Iron, finished in black enamel. For illustration see page 206. **Each**..... **$0.90**

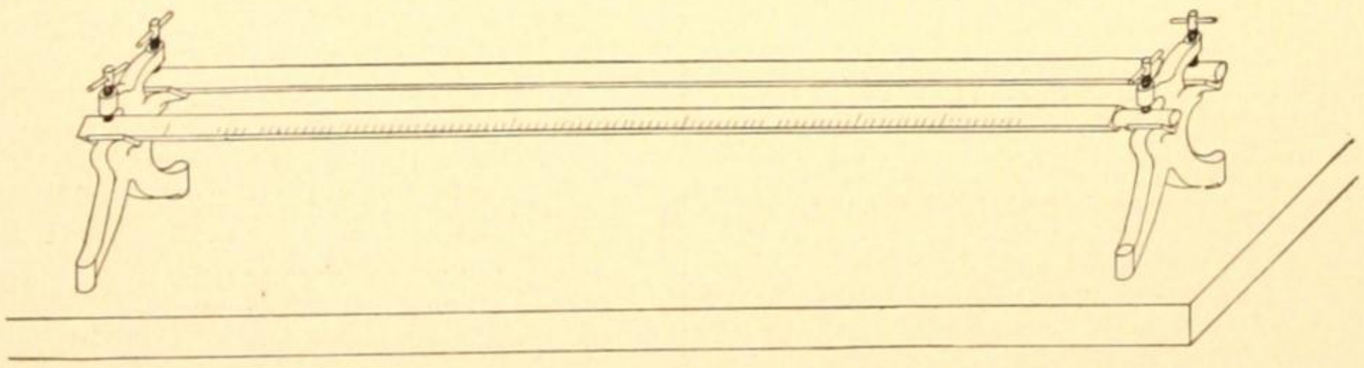
474K. Supports, End, Double-Rod Type. For supporting two 19 mm. square rods 7.5 cm. apart and parallel to a table top as required in optical bench and photometry work. For supporting lens holders, screens, photometer boxes, etc., on double-end benches see No. 44T Sliding-Index Clamp. One support only is supplied with a leveling screw. For illustration see page 206. **Per pair**..... **$5.00**

407K. Clamp, Sliding-Index, Single-Rod Type. V-groove fits 19 mm. square bench rod and vertical hole is drilled for 10 mm. diameter rod of bench accessories. For illustration see page 206..... **$1.00**

408K. Clamp, Sliding-Index, Single-Rod Type. Same as No. 407K, but with vertical hole drilled for 13 mm. diameter rod of bench accessories. For illustration see page 206 ..... **$1.65**



Single-Rod Bench assembled from Nos. 472K and 452K.



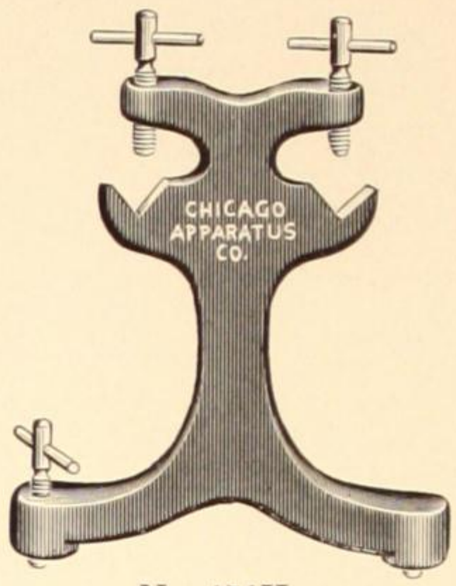
Double-Rod Bench assembled from Nos. 474K, 452K, and 174T.



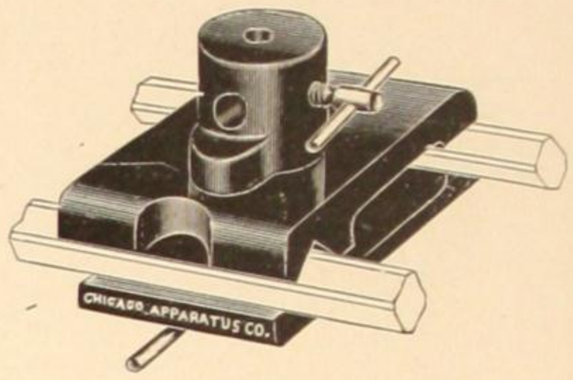
Nos. 407K-408K.



No. 472K.



No. 474K.



No. 44T.



Nos. 27K-37K.



No. 122K.



No. 127K.



No. 58T.

409K. Clamp, Sliding-Index, with Spring. Same as No. 407K, but with spring so that it can be moved along the rod without loosening the set screw, a great convenience when used with photometer boxes. V-groove, 19 mm.; vertical hole, 10 mm. **$2.50**

44T. Clamp, Sliding-Index, Double-Rod Type. For use on double-rod bench formed by two 19 mm. square rods held in No. 474K End Supports. Vertical hole is drilled for 10 mm. rod of bench accessories, horizontal hole for 13 mm. rods **$5.25**

58T. Clamp, Sliding-Index, Right-angle Type. V-groove fits 19 mm. square rod, horizontal hole is drilled for 6 mm. rod. For holding No. 410K Eyeshades **$1.25**

60T. Clamp, Sliding-Index, Right-Angle Type. V-groove fits 19 mm. square rod, horizontal hole is drilled for 13 mm. rod. For holding No. 476K Universal Holder **$0.90**

Illuminants for Optical Benches

513K. Arc Lamp, Electric. Like our No. 512K Right-angle type, hand slide feed, in aluminum housing, on 10 mm. rod to fit No. 407K Clamp. Including suitable rheostat **$25.00**

27K. Candles, Paraffine, Twelves. Length 12.5 cm.; weight per twelve, about 1 lb.; candle power, about 1.25. **Per dozen** **$0.25**

32K. Candles, Paraffiine, Sixes. Length, 22.5 cm.; weight per six, about 1 lb.; candle power, about 1.25. **Per dozen** **$0.50**

37K. Candles, Standard. Length, 12.5 cm. When burning, this candle consumes 120 grains (7.776 grams) of wax per hour, yielding one candle power of light, and hence is much used on photometers and optical benches as a standard for comparison. **Each** **$0.40**

42K. Candles, Wax. Colored Christmas candles, about 3¾ inches long by ⅜ inch diameter. In boxes of 36. **Per box** **$0.20**

412K. Gas Burner. Standard gas pillar with lava tip, on 10 mm. rod to fit No. 407K Clamp **$0.65**

122K. Lamp, Kerosene. Brass, with wick 1 cm. wide. For use as source of light. Height overall, about 14 cm. Including lamp and chimney **$0.45**

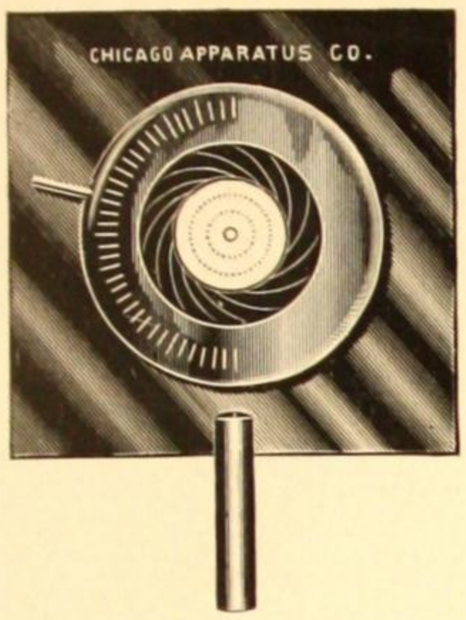
127K. Lamp Shade. A metal cylinder with a small hole in it. When placed over the chimney of No. 122K Lamp, it provides a narrow beam of light **$0.35**

419K. Lamp, Standard Incandescent, Carbon Filament. A selected 110-volt, 16 C.P., 64 watt carbon filament lamp standardized for stationary use and furnished with certificate of candle power from a Recognized Testing Laboratory. Accuracy of rating, ¼% **$5.25**

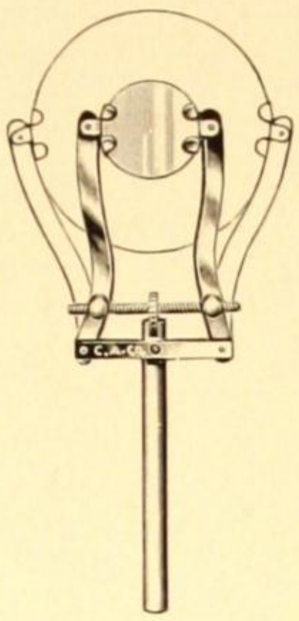
420K. Lamps, Standard Incandescent. Mazda tungsten filament lamps of special construction carefully selected, aged, standardized and certified. More satisfactory as light standards than carbon filament lamps. Each lamp is accompanied by a standardization certificate from the Photometric Testing Laboratory with the number corresponding to that of the lamp, upon which is recorded all of the data pertaining to the lamp—volts, amperes, horizontal candle power, watts per candle, etc. The accuracy maintained is .3 per cent or better. In ordering specify the voltage at which the lamp should be standardized (anywhere between 100 and 130 volts) and the watt-size desired. For stationary use.

Watts	25	40	50
Each	**$11.50**	**11.50**	**11.50**

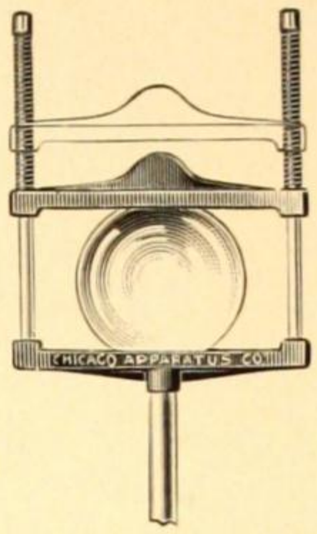
477K. Welsbach Burner. Complete with mantle and mica chimney. On 10 mm. rod to fit No. 407K Clamp **$2.00**



No. 413K.



No. 424K.



No. 425K.



Nos. 232K-237K.



Nos. 40J-45J.



No. 46J.

Photometer Boxes

447K. Photometer Box, Bunsen. The screen is Dibdin's modified form in which the light passes through a star of thin paper instead of a grease spot. On 10 mm. rod to fit No. 407K Clamp.....**$3.75**

448K. Photometer Box, Joly. In this form two translucent blocks replace the thin paper star. This type is best suited for lecture purposes. On 10 mm. rod to fit No, 407K Clamp.....**$4.25**

449K. Photometer Box, Lummer-Brodhun. Contrast Type, in which the two sides of the screen are brought simultaneously into view by a combination of mirrors and prisms. The observer sees the field of view divided into two portions by a fine dividing line. This line completely disappears when the proper adjustment between the two light sources has been attained. On 10 mm. rod to fit either No. 407K or 409K Clamp **$95.00**

Miscellaneous Equipment for Optical Benches

397K. Candle Holder, Single. For one candle (paraffine or standard), on 10 mm. rod to fit No. 407K Clamp **$0.65**

402K. Candle Holder, Quadruple. For four candles (paraffine) on 10 mm. rod to fit No. 407K Clamp **$0.85**

413K. Diaphragm, Iris Form. Instantly adjustable to any aperture from 2½ to 30 mm. in diameter. A graduated scale enables resetting to any previously used aperture. On 75x75 mm. metal plate, on 10 mm. rod to fit No. 407K Clamp.....**$6.00**

410K. Eyeshades. Of opaque black cloth, on 6 mm. rods to fit No. 58T Clamp. (Illustrations Nos. 531K and 535K shows these Shades in use.) **Per pair $2.00**

422K. Lamp Socket, Edison. For supporting regular or standardized incandescent lamps. With wire terminals and on 10 mm. rod to fit No. 407K Clamp **$1.25**

424K. Lens Holder with Screw Adjustment. For lenses and mirrors 2.5 to 10 cm. in diameter, on 10 mm. rod to fit. No. 407K Clamp.....**$2.00**

425K. Lens Holder, Farwell-Stifler Type. For lenses and prisms up to 80 mm. in diameter, on 10 mm. rod to fit No. 407K Clamp. Holds lenses between grooved members under spring tension.....**$1.25**

232K. Mirror, Concave. Glass, optically ground and silvered; 4 cm. diameter, 25 cm. focus. Fits either No. 424K or 425K Holder.....**$1.00**

237K. Mirror, Convex. Glass, optically ground and silvered; 4 cm. diameter, 25 cm. focus. Fits either No. 424K or 425K Holder.....**$1.00**

40J. Mirror, Concave. Glass, optically ground and silvered; 80 mm. diameter, 80 cm. focus. With aluminum protecting back. Fits either No. 424K or 425K Holder **$2.00**

45J. Mirror, Concave. Glass, optically ground and silvered; 80 mm. diameter, 15 cm. focus. With aluminum protecting back. Fits either No. 424K or 425K Holder **$2.00**

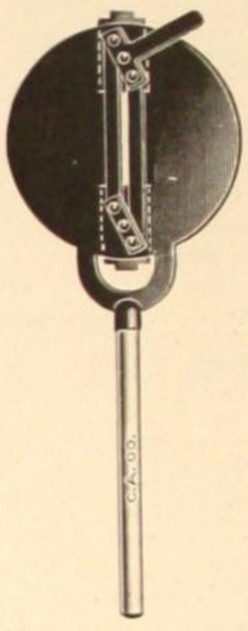
46J. Mirror, Convex. Glass, optically ground and silvered; 80 mm. diameter, 15 cm. focus. With aluminum protecting back. Fits either No. 424K or 425K Holder **$2.00**



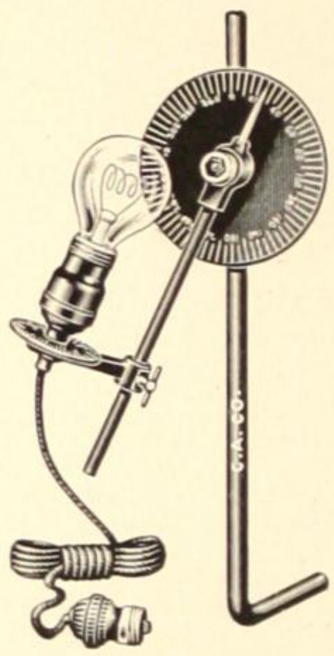
No. 437K.



No. 442K.



No. 469K.



No. 476K.

432K. Mirror, Plane. Silvered glass, 3 cm. in diameter for use in No. 424K Lens Holder.....**$0.30**

434K. Mirror, Plane and Concave. 5 cm. diameter, 7.5 cm. focus, of glass with silvered backs. In ring mount adjustable about a horizontal axis. On 10 mm. rod to fit 407K Clamp.....**$6.00**

437K. Mirror, Concave and Convex, Spherical. Glass, 12 cm. in diameter, 25 to 30 cm. focus, silvered backs. In wooden frame on 10 mm. metal rod to fit No. 407K Clamp **$3.25**

442K. Object, Arrow-Shaped. Of metal, 5 cm. long, on 10 mm. rod to fit No. 407K Clamp.....**$1.50**

455K. Rotator. For rotating incandescent lamp under test to obtain horizontal candle power. On No. 407K Clamp to fit single 19 mm. square rod..**$20.00**

457K. Screen Holder. For holding cardboard screens, glass screens, wire gauzes, etc., measuring 10x10 cm. On 10 mm. rod to fit No. 407K Clamp.....**$1.15**

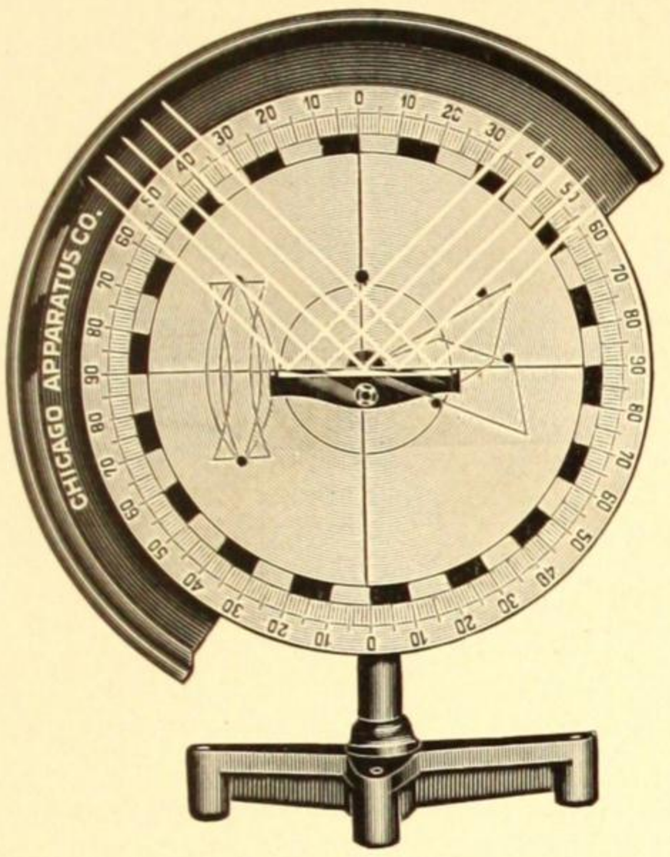
462K. Screen, Metal. Optical black finish, 10x10 cm., on 10 mm. rod to fit No. 407K Clamp.....**$1.00**

467K. Screen, Opalescent. Ground glass plate, 20x20 cm., in metal frame, on 10 mm. rod to fit No. 407K Clamp **$2.50**

469K. Slit, Vertical, Adjustable. For forming slits of any size up to 50 mm. long and 10 mm. wide. Width adjustment is controlled by a lever, length adjustment by two sliders movable in vertical grooves. On circular metal plate with 10 mm. rod to fit No. 407K Clamp.....**$6.00**

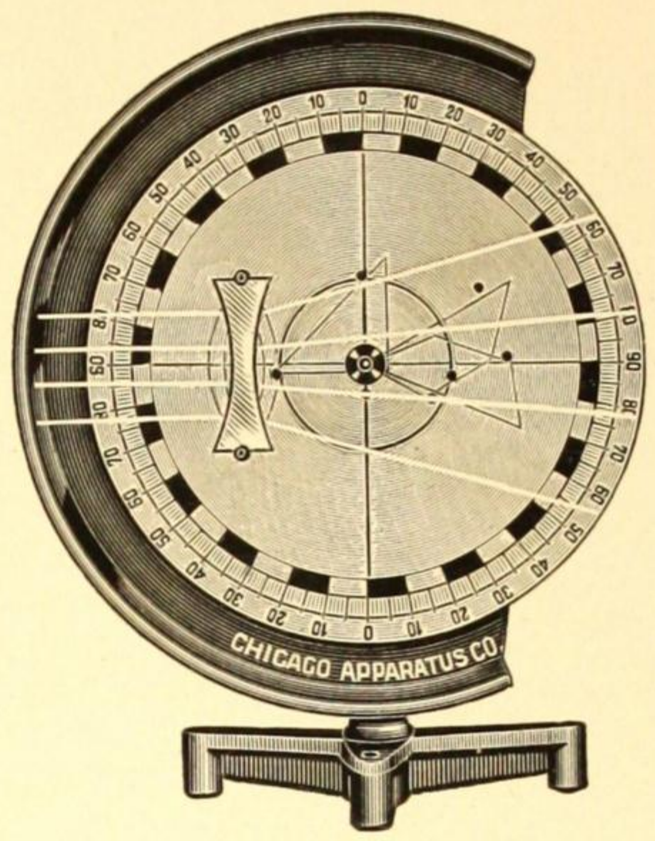
476K. Universal Holder. For holding an incandescent lamp, the candle-power of which is to be determined, in different positions. Both dials are graduated and provided with index pointers so that positions can be recorded, and duplicated when desired. Bent support rod is 13 mm. in diameter and fits No. 60T Clamp. (Illustrations Nos. 531K and 535K show this Holder in use.).....**$15.00**

Milvay Optical Disk



No. 502K.

Reflection of Light Rays from a Plane Mirror.

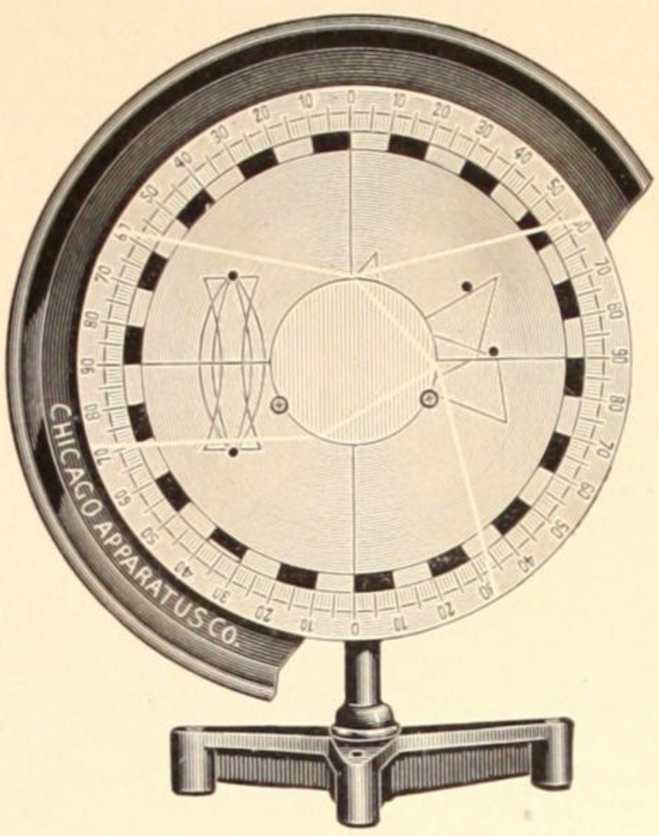


No. 502K.

Divergence of Light Rays from a Double Concave Lens.

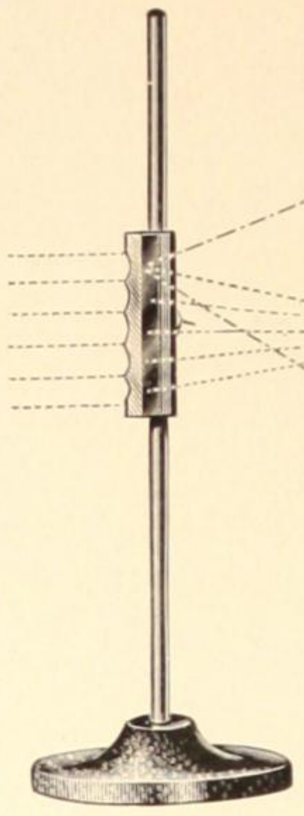
The above illustrations show some of the many optical demonstrations possible with the Milvay Optical Disk.

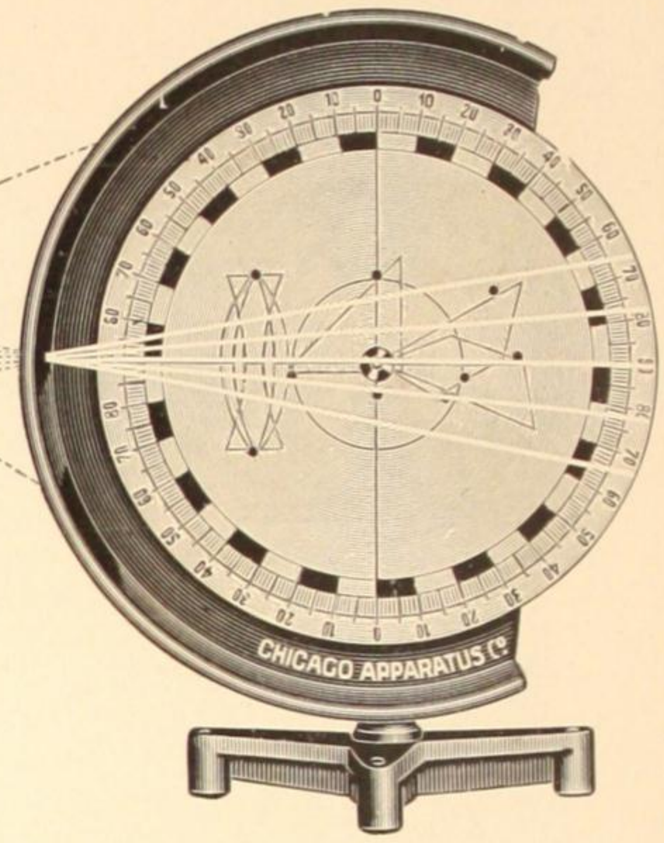
502K. Optical Disk, Milvay. For demonstrating all fundamental laws of optics in a clear, simple and effective manner. It visualizes not only the paths of the incident and reflected or refracted rays, but also reveals the paths of the rays through the special lenses and prisms themselves. That is why the optical disk gives students such a clear understanding of optical principles. That is why the optical disk is today used with the utmost satisfaction in thousands of schools. The Milvay represents the highest degree of perfection reached in optical disk construction. The Chicago Apparatus Company was the first to discard the paper dial, which was objectionable because of its natural tendency to wrinkle, curl and peel. Eighteen years ago we introduced the snow-white enameled steel dial which today is still superior to all other types of dials. It produces sharper ray contrast resulting in clearer and more brilliant demonstrations. It does not tarnish or fade from age. Its original brilliance can always be restored by simply washing with soap and water. Its large, bold figures are clearly legible across a large room. Each Milvay Optical Disk is furnished complete with a set of accessories including: Plane mirror—Concave and Convex mirror—Double-Convex lens—Double-Concave lens—Triangular prism 90° —Trapezoidal prism 45° and 60°—Hemispherical lens—spherical lens—two colored glass screen—and two opaque screens, in neat compartment box. An illustrated booklet describing in detail the many experiments which can be performed with the Milvay Optical Disk is also included.....**$22.50**



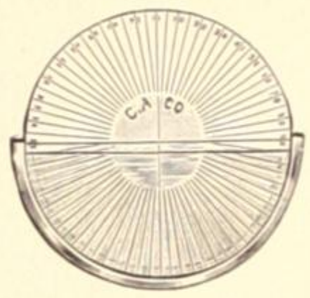
No. 502K.

Demonstrating the Formation of the Primary and Secondary Rainbow.

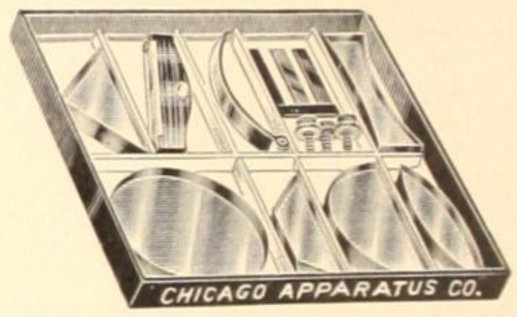




No. 507K (In Use).



No. 517K.



No. 508K.

Optical Disk Accessories

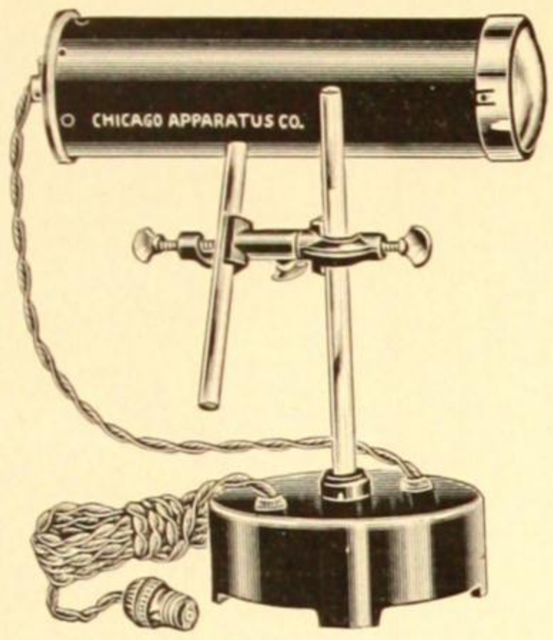
505K. Polarized Light Attachment. To be attached to the face of the Optical Disk for demonstrating the phenomena of polarized light to a class. The polarizer consists of a bundle of transparent glass plates, all or one of which may be used. The analyser consists of an elliptical black glass mirror rotatable about the optical axis of the polarizer. In front of the analyser is a glass screen for receiving the image so that it may be viewed by the class. A suitable specimen holder is mounted between the polarizer and analyser. (For specimens suitable for use with this attachment see Nos. 4125K or 4160K.) Complete, but without specimens.....**$16.00**

507K. Diverging Ray Attachment. Consists of glass plate forming a system of concavo-cylindrical lenses mounted in a frame and adjustably mounted in a clamp on an iron stand. In use this attachment is placed between the Optical Disk and the light source. Each individual concavo-cylindrical section sends out a bundle of diverging rays and one ray from each lens will pass through the slit in the screen, forming a series of diverging rays which appear to come from the slit as a source and cross the face of the dial. The diverging of these bundles may be varied by increasing or decreasing the distance of the attachment from the disk. With these bundles all the experiments which were performed with parallel rays may be repeated with diverging rays. It provides the means of effectively explaining and illustrating the action of optical instruments. When a short-focus convex optical disk lens is used in combination with the long-focus convex optical disk lens of No. 502K, the fact that an extra lens makes the image either recede or approach the first lens is shown, thus illustrating the action of eyeglasses. Complete, as illustrated, including a short-focus convex optical disk lens and metal screen for same.**$9.00**

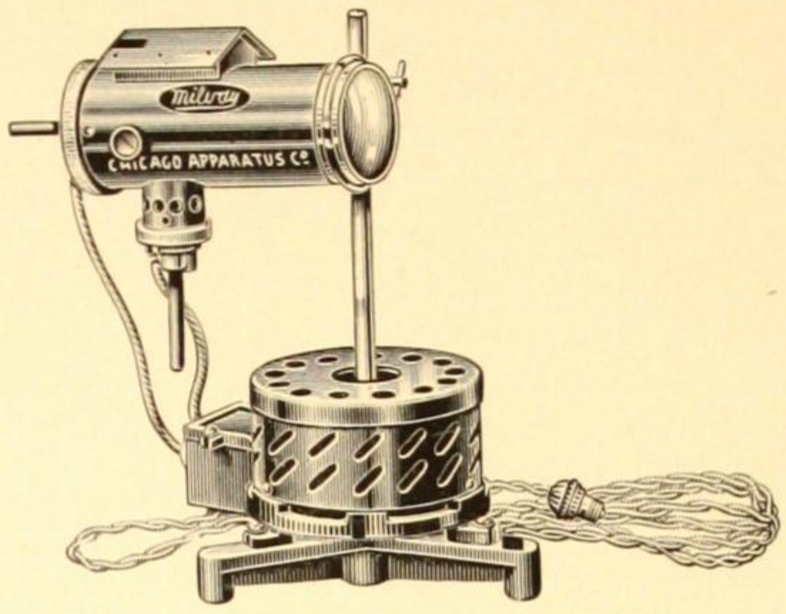
517K. Refraction Tank, Milvay. For determining the index of refraction of water and other transparent liquids. For fastening to the center of the Optical Disk. Consists of a circular metal tank, about 10 cm. in diameter, with glass front, and so designed that the water level may be used at the 90-90 mark. The back of the tank is graduated so that quantitative determinations may be made. Including clamps for holding plane mirror to edge of disk for reflecting horizontal rays down into the tank at any desired angle **$6.75**

508K. Optical Disk Accessories Set. This set is furnished with No. 502K Optical Disk and is listed separately for convenience in ordering additional sets. Includes: Plane mirror—Concave and Convex mirror—Double-convex lens—Double-concave lens—Triangular prism 90°—Trapezoidal prism 45° and 60° Hemispherical lens—Spherical lens—Two colored glass screens—Two opaque screens. In neat compartment box **$8.50**

Milvay Optical Disk Illuminators



No. 509K.



No. 512K.

509K. Milvay Transformer-Operated 50 C.P. Incandescent Illuminator. In this new Milvay product the 110-volt line pressure is reduced to 24 volts, the correct lamp-operating voltage, by means of a transformer instead of the usual resistance units. So large a voltage reduction through resistances generates excessive heat with much waste of current. Then, too, all parts in close proximity to the heated units become so hot that they cannot be touched or handled. Furthermore, they scorch or otherwise damage anything that may come into contact with them. The highly efficient transformer employed in this Milvay Illuminator does not warm up in the least degree even after hours of continuous service. It remains cool and can, therefore, be handled, moved and adjusted easily and without discomfort. Since the transformer delivers correct lamp-operating voltage at all times a beam of maximum brilliance always results. Furthermore, there is no need for a voltage-regulating device. As a consequence the Milvay is the simplest illuminator on the market and the easiest to operate. Just plug it in and it instantly yields a beam of parallel rays of sufficient intensity to insure good results in elementary optical disk experiments—those involving simple reflection and refraction. The Mazda lamp employed is the highest candle power (50) available with sufficient concentration of filament to insure powerful rays. This lamp is mounted in a strong metal housing which may be tilted to any angle or adjusted vertically to any height from 9½ to 16½ inches above the top of the table. The lens is 3 inches in diameter and is properly focused by moving the lamp back or forth in its adjustable mount. Once properly adjusted, the lamp can be securely locked in position. The circular, heavy iron base is 6 inches in diameter and finished in black gloss enamel. The lamp housing is finished in optical black while other metal parts are nickel-plated. The transformer, which is mounted in the base, adds greatly to the stability of the instrument. We can highly recommend this illuminator because it yields such good results, does not heat and is so easy to operate. For use on 110-volt A.C. circuits. Complete with 8-ft. cord and two-piece separable plug.....**$15.00**

510K. Milvay 50 C.P. Incandescent Illuminator. Same as No. 509K, but with resistance unit in base. For use on 110-volt D.C. circuits.....**$15.00**

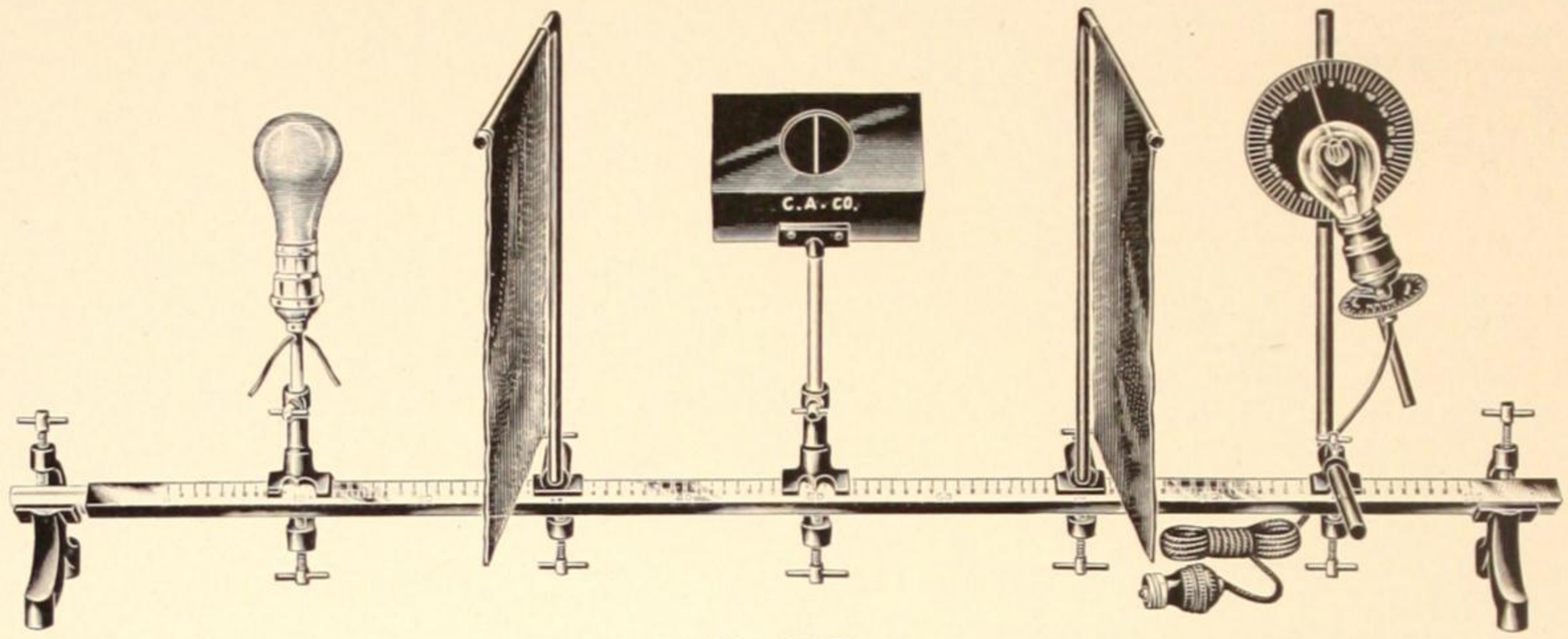
511K. Extra Bulb for No. 509K.....**$0.75**

512K. Illuminator, Milvay, 800-Candle Power Arc. Provides the two requisites for satisfactory optical disk and optical bench work—rays of great intensity and true parallelism. The only artificial light rays having both these properties are those issuing from the electric arc. In incandescent lamps intensity must be sacrificed to gain parallelism, or vice versa. Consequently, incandescent lamps with the largest permissible point-source filaments are of comparatively low intensity—about 32 candle power —only a small fraction of arc light intensity. To make the arc-type illuminator as simple and convenient as the incandescent type, our engineers have done two things: First, they have devised an extremely simple and effective hand-feed for the carbons. Second, they have built the entire outfit into a single compact unit, that needs only to be plugged into any lighting socket to be ready for use. The simple hand-feed consists of split chucks which open against spring pressure and which will handle either $\frac{5}{16}$ or $\frac{7}{16}$-inch carbons. Opening the chucks allows instant and full removal or insertion of the carbons —an entirely new feature in hand-feeds. The bores of the chucks are threaded, turning the carbons quickly moves them in or out to just the proper point. The action is always smooth, free, easy and positive—spring pressure provides this. Heat has no effect on this feed mechanism; hence jamming and sticking is impossible. Two blue glass windows provide a good view of the arc from either side. The lamp house is of aluminum with ample provision for ventilation. The lens is fitted into a focusing mount. The rheostat is mounted centrally on the heavy supporting base. The lamp house is adjustable vertically through a distance of 8 inches and the supporting clamp, being provided with an inclination joint, permits tilting it to any desired angle. For use on any 110-volt A.C. or D.C. circuit. Complete with cord, plug and twelve carbons....**$25.00**

Extra Carbons for No. 512K Milvay Illuminator

1330K. Carbons. Cored, $\frac{5}{16}$ inch diameter, 6 inches long, per ten **$0.80**

PHOTOMETERS

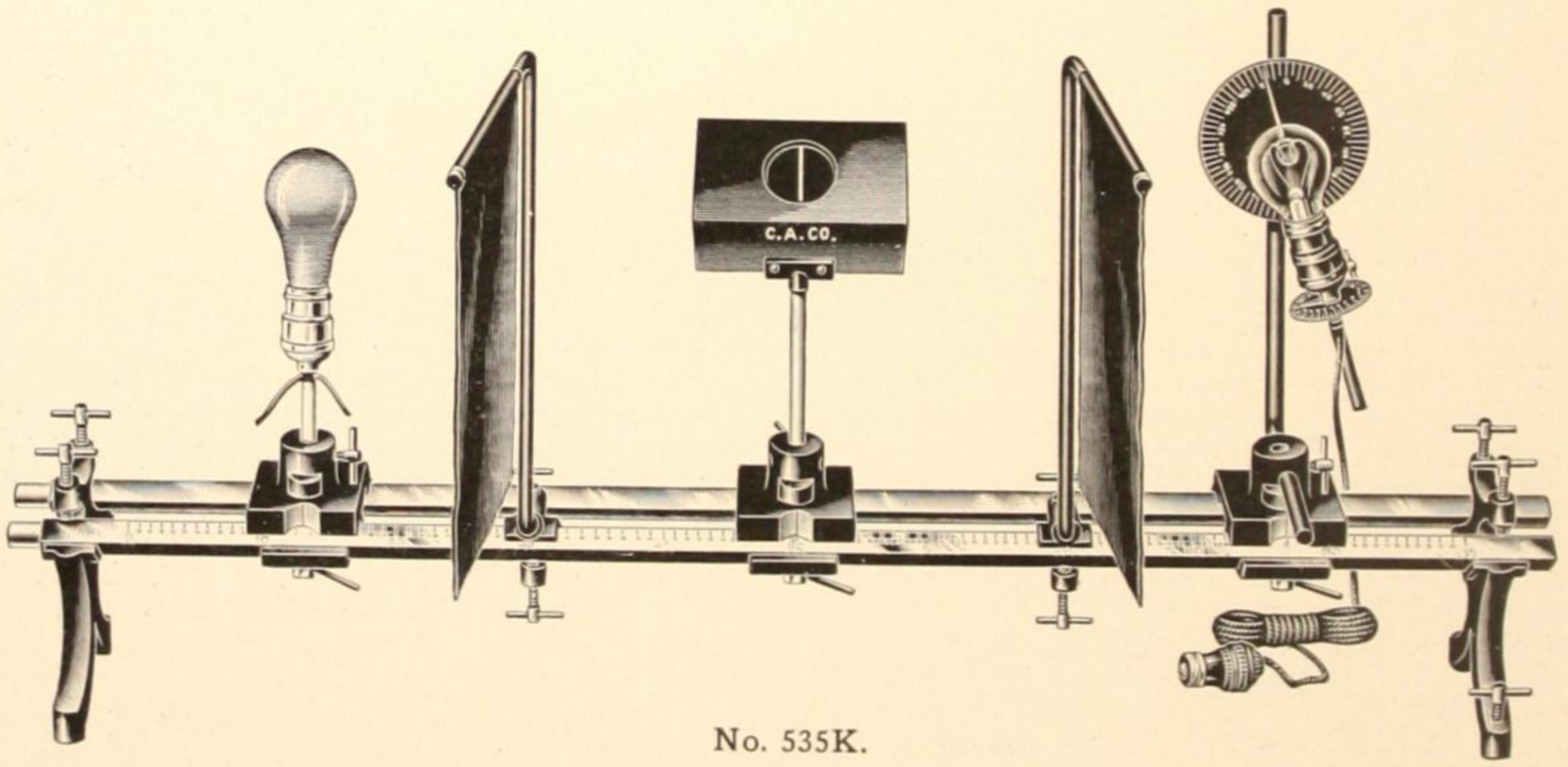


No. 533K.

531K. Photometer, Elementary Laboratory, Single-Rod Type. Consists of 1 No. 452K Graduated Rod, one meter long; 2 No. 472K End Supports; 1 No. 418K5 Mazda Incandescent Lamp, 110-volt, 40 watt; 1 No. 477K Welsbach Burner; 1 No. 422K Socket on Rod; 1 No. 447K Bunsen Photometer Box; and 3 No. 407K Sliding-Index Clamps.....**$26.00**

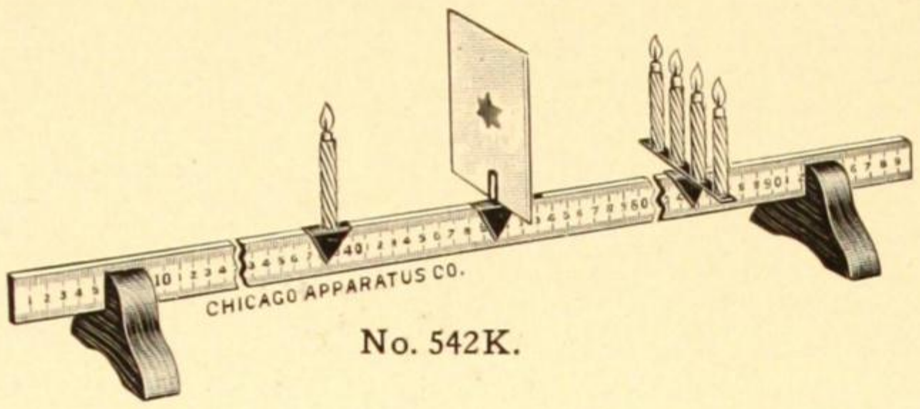
533K. Photometer, Advanced Laboratory, Single-Rod Type. For standardizing incandescent lamps. Consists of 1 No. 453K Graduated Rod, two meters long; 2 No. 472K End Supports; 1 No. 419K Standard Incandescent Lamp; 1 No. 422K Socket on Rod; 1 No. 407K Sliding-Index Clamp; 1 No. 476K Universal Holder; 1 No. 60T Right Angle Clamp; 1 No. 447K Bunsen Photometer Box; 1 No. 409K Sliding-Index Clamp with Spring; 1 pr. No. 410K Eye Shades; and 2 No. 58T Right Angle Clamps **$50.00**

535K. Photometer, Advanced Laboratory, Double-Rod Type. Consists of 1 No. 453K Graduated Rod, two meters long; 1 No. 175T Plain Rod, two meters long; 1 pr. No. 474K End Supports; 3 No. 44T Double-Rod Type Bridge Clamps; 1 No. 419K Standard Incandescent Lamp; 1 No. 422K Socket on Rod; 1 No. 476K Universal Holder; 1 No. 60T Right Angle Clamp; 1 No. 447K Bunsen Photometer Box; 1 pr. No. 410K Eye Shades; 2 No. 58T Right Angle Clamps **$72.50**

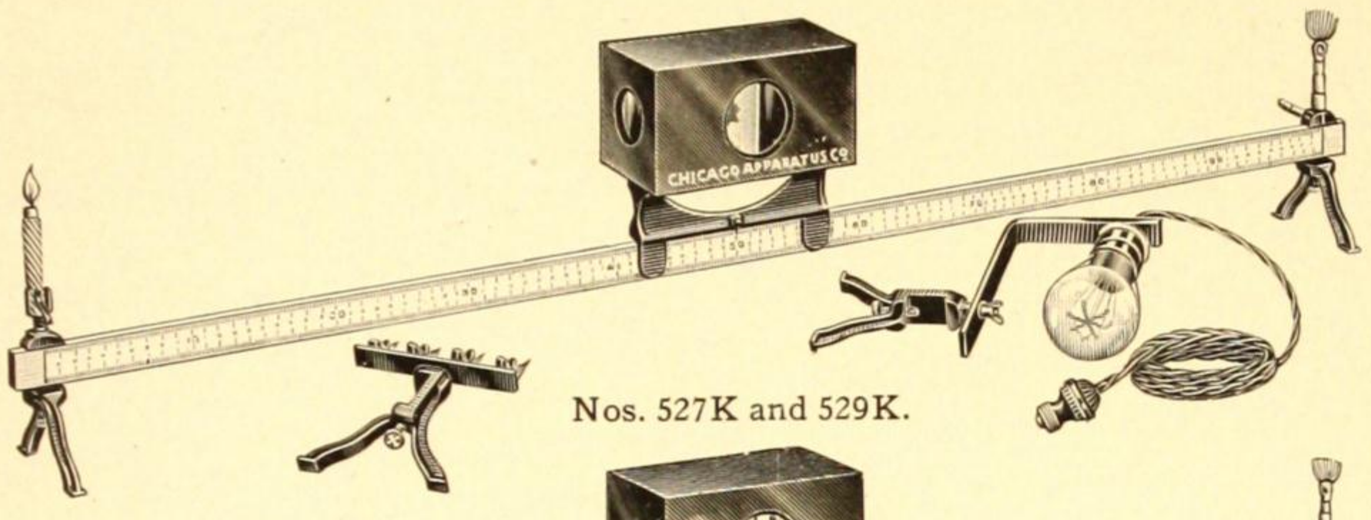


No. 535K.

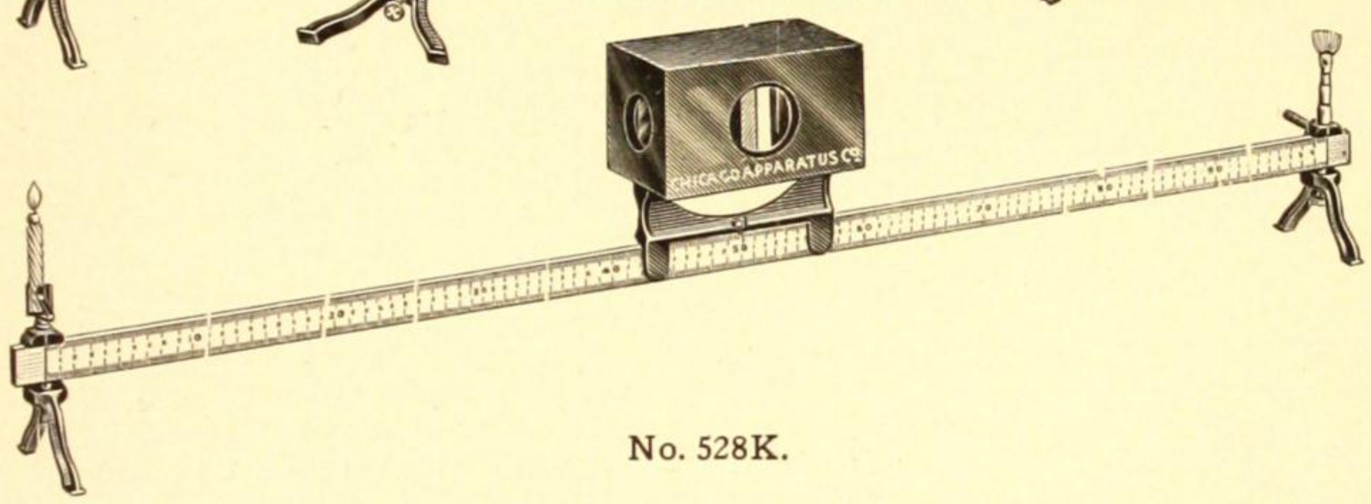
Note: Parts from which these photometers are assembled are listed on pages 205 to 208.



No. 542K.



Nos. 527K and 529K.



No. 528K.

542K. Photometer, Elementary. As used in Millikan, Gale and Bishop's Course. Consists of No. 358M Meter Stick, No. 302K Single Candle Holder, No. 307K Quadruple Candle Holder, No. 347K Bunsen Screen, No. 367K Screen Support, No. 42K Candles and a pair of No. 378K Supports.....**$1.40**

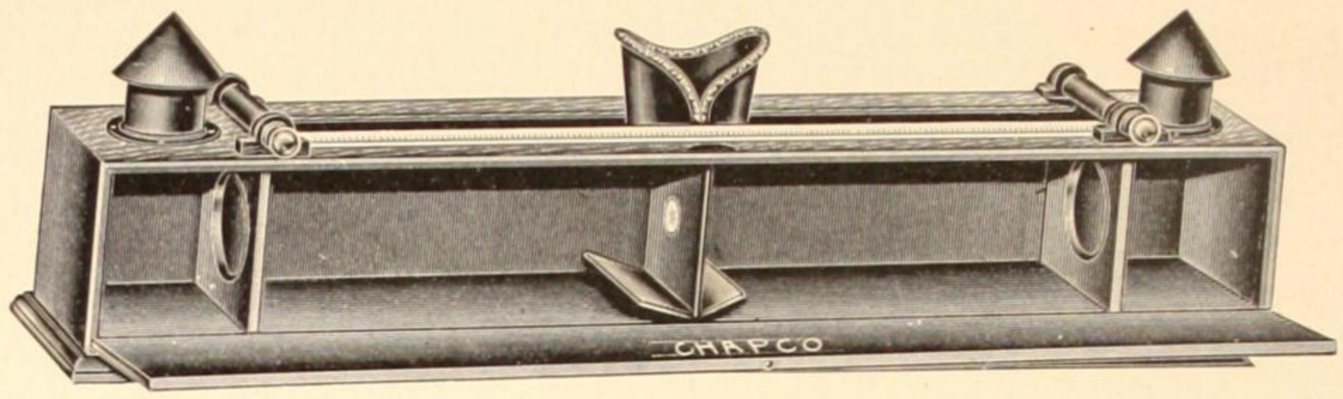
We have greatly improved the sliding qualities of our Photometer Boxes by making the portion that rests on the meter stick of metal. The groove is accurately cut and designed so that the box will move along the meter stick with very little friction. The present construction is a distinct improvement, as it overcomes the objectionable warping and sticking of the all-wood type. In the Bunsen type the screen is Dibdin's modified form, in which the light passes through a star of thin paper instead of a grease spot. In the Joly, two translucent blocks take the place of this screen. They are separated only by a thin metal diaphragm. When the intensity of the light falling on each block is different, one block appears much darker, the line of division being very marked. As soon as the intensity on both sides is the same this marked difference disappears. A very slight difference in intensity is very easily noticeable, hence very accurate results are possible with this type of Photometer. In lecture work it has a distinct advantage over the Bunsen type, as the ends of the blocks are easily visible over a large room and may be viewed from any angle, while the images of a Bunsen screen are visible only a short distance and must be viewed from directly in front. Joly Photometers of the design listed below have been used in Chicago high schools for many years with good success.

527K. Photometers, Bunsen, Student's Form. Consists of a No. 332K Easy-Sliding Bunsen Photometer Box, No. 314K Gas Burner, No. 309K Single Candle Holder and No. 358M Full Meter Stick.**$4.35**

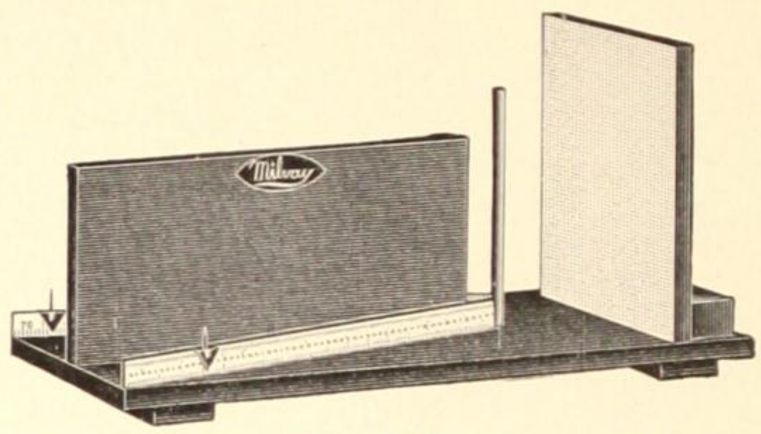
528K. Photometer, Joly, Students' Form. Consists of No. 333K Easy-Sliding Joly Photometer Box, No. 314K Gas Burner, No. 309K Single Candle Holder and No. 358M Full Meter Stick.....**$6.35**

529K. Photometer, Bunsen, Students' Complete Outfit. Includes No. 332K Easy-Sliding Bunsen Photometer Box, No. 309K Single Candle Holder, No. 310K Quadruple Candle Holder, No. 314K Gas Burner, No. 319K Lamp Socket and No. 358M Full Meter Stick. A most satisfactory equipment for elementary work in photometric measurements. Without lamps or candles.....**$8.00**

530K. Photometer, Joly, Students' Complete Outfit. Same as No. 529K, but with No. 333K Easy-Sliding Joly Photometer Box in place of No. 332K Bunsen Box **$10.00**



No. 537K.



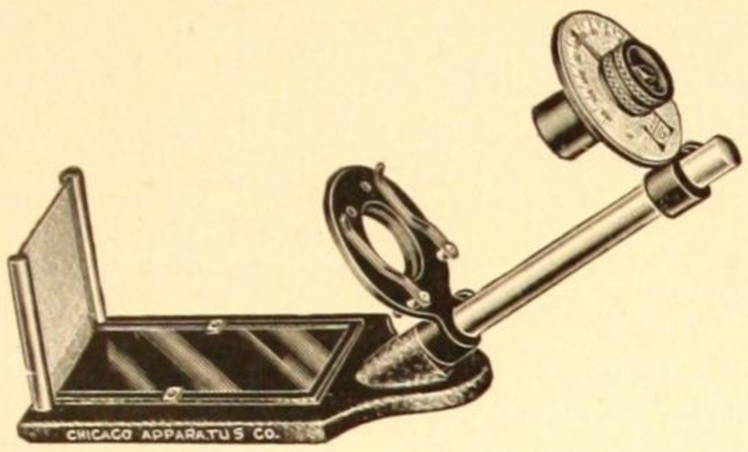
No. 547K.

537K. Photometer, Bunsen, Daylight Type. Can be used in a light room. No dark room needed. The Bunsen screen is viewed through a shaded slot mounted upon a strip of light-proof fabric fitted into grooves upon the top of the box. The screen and mirrors are also attached to this light-proof fabric directly under the viewing slot. The ends of this fabric pass over rollers. By turning the rollers the screen may be readily moved to any point of the scale between the lamps. The distance between the screen and the illuminants is indicated upon a graduated scale mounted on top of the box. A single light-proof door running the entire length of the photometer affords easy access to the lights and mirrors. The door remains closed throughout the experiment. This instrument, exclusive of the ventilators and hood, is 17 cm. wide, 20 cm. high and 115 cm. long **$30.00**

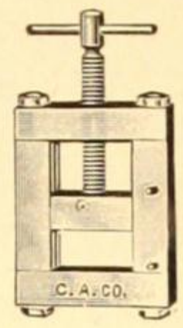
538K. Electric Light Attachment. For use with 537K Photometer. Enables the use of an electric light at each end of the photometer. Complete, with two sockets, two plugs and two six-foot lengths of lamp cord, but without lamps..... **$9.00**

547K. Photometer, Rumford's. A wooden base, 30x70 cm., on which are mounted two half-meter sticks meeting at an angle; an upright metal rod; two movable wooden screens, one with white cardboard attached for receiving the shadows, and the other for separating the two lights. Base and screens are finished in dull black. Complete with two No. 302K Single Candle Holders **$7.50**

552K. Pins. Ordinary bankers pins for use in reflection and refraction experiments. Length, about 30 mm..... **Per package of 200 pins $0.10**



No. 553K.



No. 4155K.

553K. Polariscope, Milvay All-Metal Type, With Adjustable Stage. For studying polarization by reflection; the effects of such light on passing through thin crystals, annealed glass plates, unannealed glass plates, and crossed glass plates; positions of extinction and maximum brilliance in such specimens; and colors and their complements produced by thin crystals in polarized light. Aside from its finer appearance, this all-metal type has other advantages over the wooden form. It is more durable, there being no wood to warp. Observations in convergent polarized light are impossible with fixed-stage types. In the Milvay, due to its adjustable stage, the specimen can be placed very close to the analyzer, thus providing a simple means for obtaining a convergent beam. It also eliminates the need for a shade, good results being had by either daylight or lamplight. The light passing through a vertical ground glass screen provides an incident beam of uniform character and intensity. This beam is reflected at the correct angle from the black glass polarizer attached to the base to produce plane-polarized light, which passes through the stage aperture and thence through the 6-mm. Nicol analyzer. The latter is mounted in a rotable metal tube provided with a pointer moving over a 180° graduated arc. Commercially, and in college work, the use of polarized light tests in determining the quality of optical glass, chemical glass, sugar, etc., is steadily increasing. Hence, work with this fine, yet simple model, leading as it does to a better understanding of the theory of polarized light, is excellent preparatory training for work with the more elaborate instruments employed in advanced laboratory and commercial work $22.50

Polariscope Specimens and Accessories

The specimens listed below will prove valuable in the experiments described in Millikan and Mill's "Electricity, Sound and Light" and in Taylor, Watson and Howe's "General Physics for the Laboratory." They are made with the same skill and accuracy as high-grade optical lenses and prisms, and are just as nicely finished. They are thoroughly tested during and after manufacture and will give the results so much to be desired in polarized light experiments. They are priced low and should not be compared with the crude unfinished and untested specimens selling—and naturally so—at somewhat lower prices. Every specimen is guaranteed against flaws, scratches, and other defects and to bear the strictest tests of comparison with any other specimens regardless of make or price.

4125K. Quarter-Wave Mica Plate. Thin mica crystal mounted on a 6x1 cm. glass plate, for illustrating the production of circularly polarized light $4.50

4130K. Half-Wave Mica Plate. Thin mica crystal, mounted on a 6x1 cm. glass plate, for illustrating the four positions of extinction, 90 degrees apart, for one complete revolution $4.50

4135K. Single Gypsum Plate. A thin gypsum crystal 13 mm. in diameter in 35x35 mm. paper-covered cork mount. For illustrating the production of colors and their complements by thin crystals in polarized light $3.60

4140K. Cross-Shaped Rapidly Annealed Glass Plate. Outside measurements 38x38 mm., by 12 mm. thick. Produces beautiful colored patterns in polarized light and reveals their complements on rotation through 90 degrees $3.00

4145K. Crossed Annealed Plates in Circular Cork Mount. Consists of two plates 38x18 mm. by 10 mm. thick sealed together to form a cross. Shows beautiful colored patterns, and "brush" effects under polarized light. Complementary colors, points of maximum illumination, points of extinction, and changes in patterns are revealed by rotation of analyzer or specimen $12.75

4150K. Unannealed Glass Plate. Measures 25x25 mm., by 10 mm. thick. Has ground edges to reduce cross-plate illumination. When placed under compression in No. 4155K Clamp the strains are revealed by the "brush" effects produced in polarized light $3.50

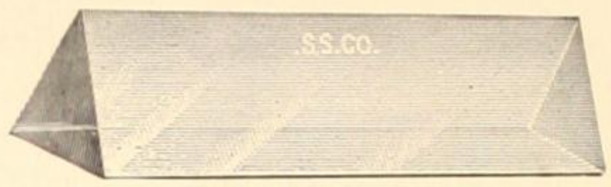
4155K. Clamp. A strong steel clamp with parallel-moving, screw-operated jaw for compressing No. 4150K Glass Plate or any similar plate up to 30x30 mm. in size. Has two lugs for securely holding it on the stage of No. 553K Polariscope so that tension may be varied while the specimen is under observation, thus revealing the effects produced by strains of varying degree $6.00

4160K. Gypsum Star. Six gypsum crystals, of different thicknesses, mounted in star formation on a 30 mm. circular plate held in a 50 mm. square paper-covered cork mount. Each star-point reveals its characteristic color under polarized light and its complement when the analyzer is rotated through 90 degrees. No specimen shows polarized light color effects in thin crystals better than this fine preparation $10.00

PRISMS



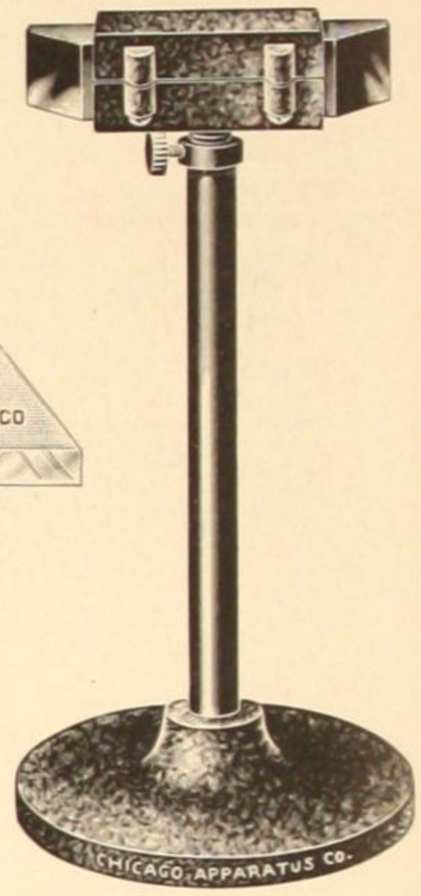
No. 554K.



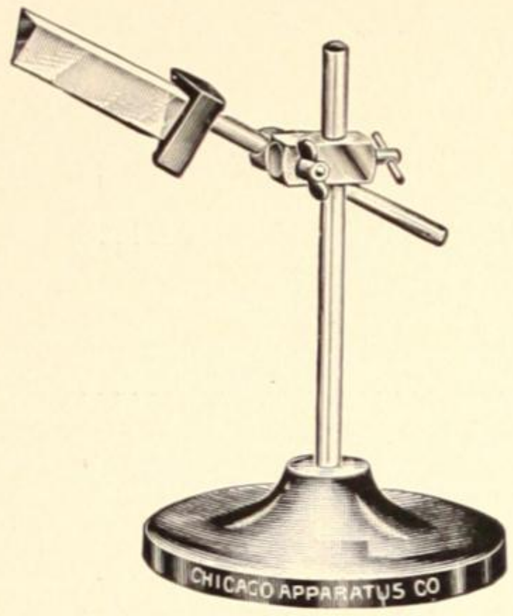
Nos. 557K-559K.



No. 560K.



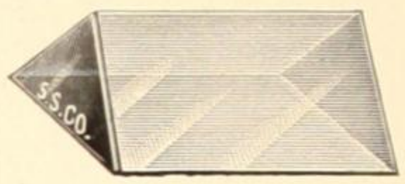
No. 580K.



No. 562K.



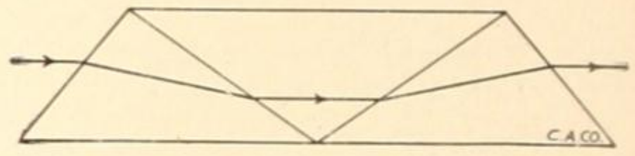
No. 567K.



No. 577K.



Nos. 572K-573K.



No. 580K. (Showing path of light rays through three-part prism).

554K. Prism, Compound. Unequaled for illustrating and studying the difference in the refractive and dispersive power of the various kinds of glass used in optical instruments. Held in the path of a beam of sunlight, it will project four separate and distinct spectrums. An equilateral prism, of fine optical quality, made up of four kinds of glass (crown, flint, etc.), each distinctly different from the other in refraction and dispersion. Width, 35 mm.; height, 32 mm. **$12.00**

557K. Prism, Equilateral. Flint glass, square ends, with a face 25 mm.; length, 75 mm..... **$0.60**

558K. Prism, Equilateral. Same as No. 557K, but 100 mm. long **$0.90**

559K. Prism, Equilateral. Same as No. 557K, but 150 mm. long **$1.25**

560K. Prism, Equilateral. As used in Millikan, Gale and Bishop's Course for determining the index of refraction of glass. Face 75x75x75 mm. thickness 10 mm. **$0.50**

562K. Prism, Equilateral, Mounted. A 4-inch flint glass prism (No. 558K) mounted on a universal adjustable stand, as illustrated. With this style of mounting the prism can be rotated about its axis, raised and lowered to any desired height and inclined to any desired angle. Mounted on japanned iron base 13 cm. diameter. Total height, 38 cm.. **$4.50**

567K. Prism, Hollow, All-Glass Type. For spectro-analytical purposes. The glass faces are of uniform thickness, free from striae, 90 mm. high by 60 mm. wide, and set at the correct angle—60 degrees. This prism is unaffected by carbon bisulphide, etc. With ground glass stopper **$6.00**

572K. Prism, Nicol's. For polarization, diagonal face, rhomboidal section. Size of face, 6 mm..... **$5.00**

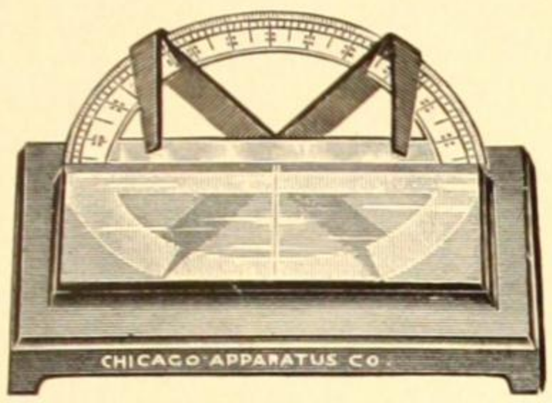
573K. Prism, Nicol's. Same as No. 572K, size of face, 8 mm. **$7.00**

577K. Prism, Right-Angled. For showing total reflection of a beam of light from within a glass prism. Flint glass, angles 45-90-45 degrees, width of widest face 32 mm., length 38 mm..... **$0.50**

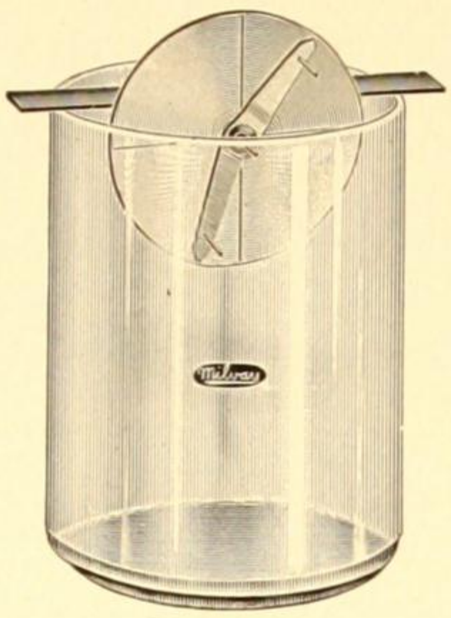
579K. Prisms, Glass, with Unequal Angles. For use in refraction experiments. Flint glass prism 75x35x 65 mm. by 20 mm. thick; angles 30, 60 and 90 degrees **$0.75**

580K. Prism, Spectrum Projection, Direct-Vision Type. For the projection of spectra in the lecture room, it is convenient to have a prism that can be placed directly between an arc illuminator or projection lantern and screen, without altering the position of the light source or screen. The best type for this purpose is one that gives dispersion without deviation, that is a straight-vision type such as is used in this instrument. With such a prism, the projection of spectra is as simple as the projection of lantern slides. The prism actually consists of a cemented system of three separate prisms as indicated in the smaller illustration. The central prism is of flint and the outer two of crown glass with angles chosen to provide a dispersion of 18° from end to end of the visible spectrum. Thus, at 7 ft. it produces a spectrum 2 ft. long; at 10 ft. a 3 ft. image; at 15 ft. a 4.5 ft. image; and at 20 ft. a 5.75 ft. image, etc. The prism measures 25x25 mm. by 112 mm. long. It is of finest optical quality and is mounted in a suitable stand providing height adjustment ranging from 25 to 45 cm. above the table top. Our No. 512K Arc Illuminator gives excellent results with this prism **$30.00**

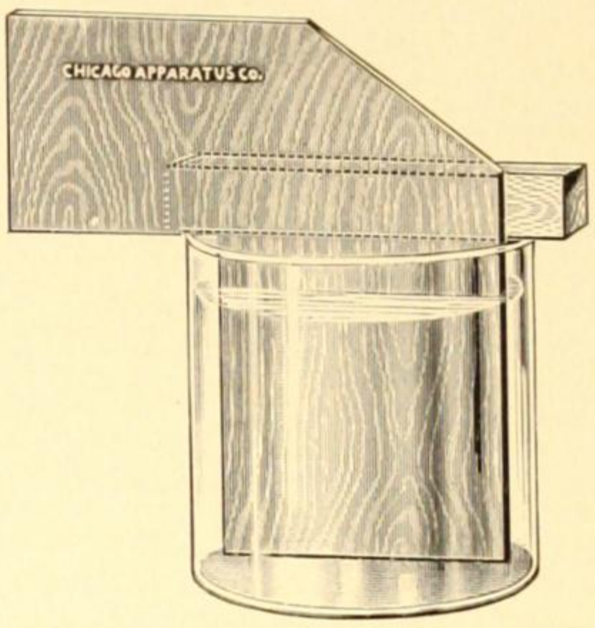
Refraction Apparatus



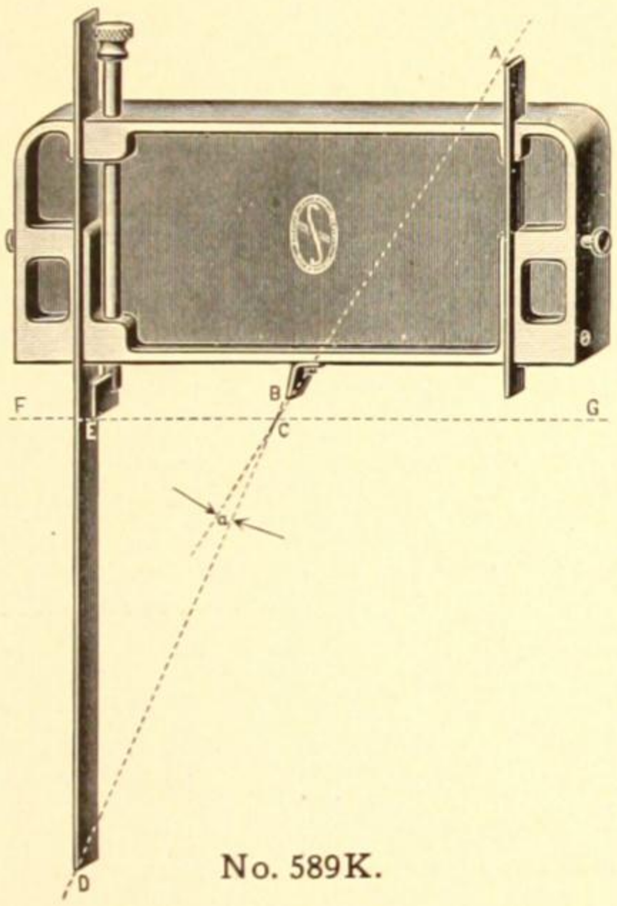
No. 582K.



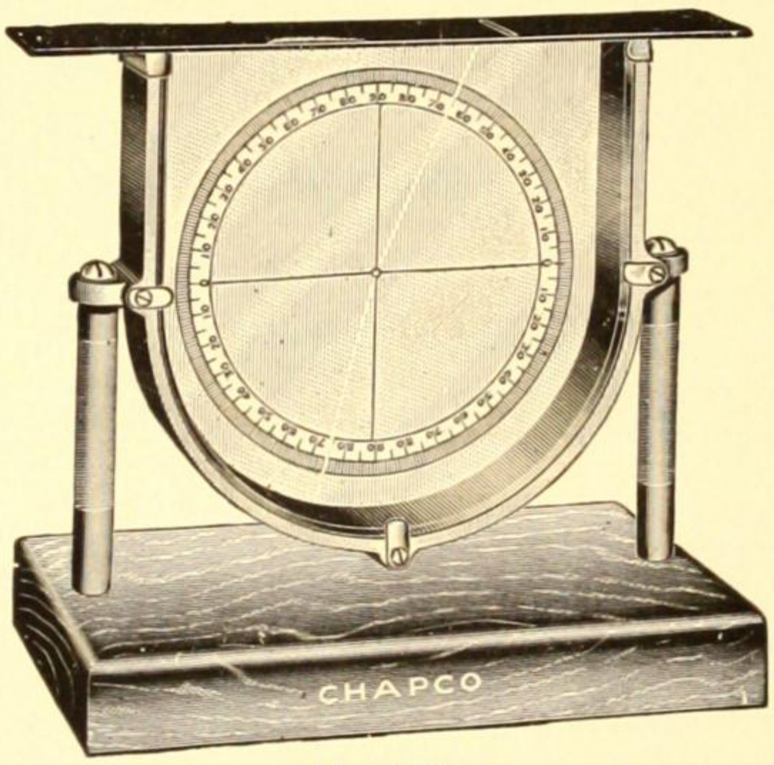
No 587K.



No. 588K.



No. 589K.



No. 592K.

582K. Reflection Apparatus. For showing that the angle of reflection is equal to the angle of incidence. Japanned iron base, 9 by 16 cm.; with mirror, graduated semi-circular protractor, and two movable sights. In use, the first sight is set at any given angle, the second sight is then adjusted until it coincides with the image of the first at the center of the mirror, which point on the mirror is indicated by an etched line. The angle of the second sight will be found to be equal to the angle of first.....**$6.00**

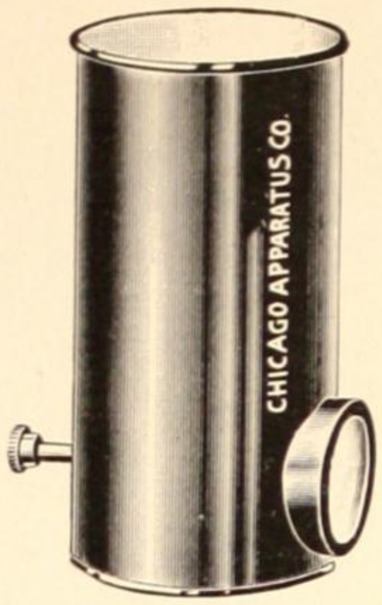
587K. Refraction Apparatus, Milvay. Metal disk 4 in. in diameter with horizontal "water" line, "normal" line, center pin, and two movable arms with pins at their outer ends. After obtaining the line of sight, which is quickly done by moving the arms, the apparatus is moved from the jar and the refraction determined by the usual method. Fits 6x8 in. round jar. Without jar.....**$3.00**

588K. Refraction Board, Dull's. For finding the index of refraction of a ray of light passing from air into water as outlined in Exp. 51 of Dull's "Laboratory Exercises in Physics." Consists of a pine board ¼-inch thick, of the shape shown, attached to a stout cross-bar and designed to be supported upon a 6-inch diameter by 8-inch high battery jar.....**$1.25**

589K. Refraction Apparatus, Pratt Institute Form. Consists of a non-corrosive 3x7 in. metal casting with adjustable sliding index strips. After the line of sight is obtained the apparatus is taken from the jar and straight edges placed on a sheet of paper and the line of sight drawn. Index of refraction is then determined by the usual methods. Fits 6x8 in. round jar **$5.00**

592K. Refraction Apparatus. For determining the index of refraction of water and other liquids. Consists of an aluminum tank 11.5 cm. in diameter with glass front and back. A full circle protractor, with 1 degree graduations, attached to the back plate, provides an accurate, direct and easy means of measuring the angle of incidence and of refraction. Mounted on finely finished 10x15 cm. hardwood base. Including metal cover with slit for admission of light beam **$7.50**

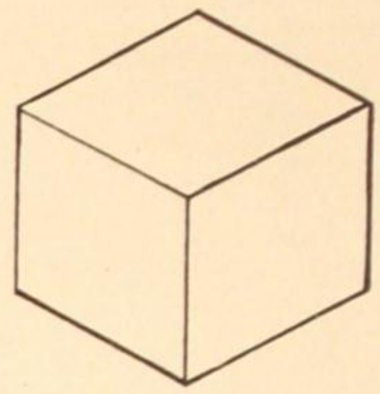
Refraction Apparatus—Cont.



No. 593K.



No. 594K.



No. 595K.



No. 596K.



No. 597K.

593K. Total Reflection Apparatus. For showing that light rays within a water stream issuing from a spout, are totally reflected. Consists of an enameled metal reservoir, 25 cm. high by 13 cm. in diameter, with a spout near the bottom opposite a large circular window. The spout is closed with a removable cap containing a small transparent window. It serves two purposes. It prevents escape of the water until desired and is useful in directing the light beam in a path through the spout.

In use the reservoir is filled with water and a powerful light beam, from our No. 512K Arc Illuminator or other source, is directed through the large window so that it will intensely illuminate the small window in the spout cap. The issuing stream, when the cap is removed, will be brilliantly illuminated throughout. Tests by bringing a small white paper screen near the stream at various points will show no escape of light rays, proving that they are always totally reflected from the walls of the stream. By interposing colored glasses between the light source and large window, the stream can be made to take on corresponding hues, thereby illustrating the principle of operation of so-called electric fountains. Such demonstrations succeed best in a semi-darkened room. To still further intensify the brilliance of the illuminated stream a converging lens should be placed between the light source and large window. If this lens be held in a support and adjusted to concentrate a small point of light on the spout cap window, the path of the light beam in the water stream is revealed, and the fact that it is repeatedly and totally reflected made visible. Without light source or condensing lens **$7.50**

594K. Refraction Apparatus. A rectangular glass jar about 6.5x10.5x17.5 cm., with flat faces, one side being provided with protractor. A metal cover, provided with a narrow slit for admission of a beam of light and snugly fitting the top of the jar, is furnished **$1.40**

595K. Refraction Cube. Solid glass, for Index of Refraction Experiments, 50 mm. on each edge.. **$1.50**

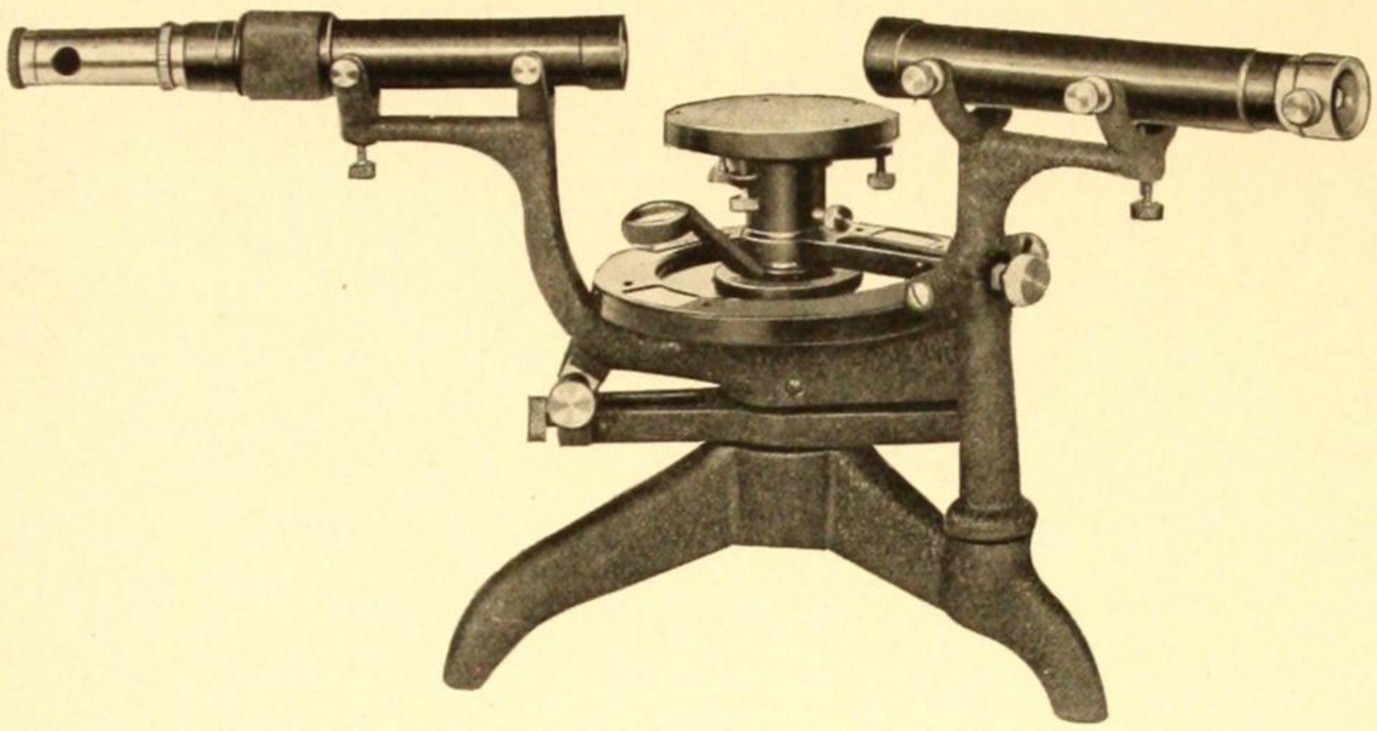
596K. Refraction Tank, Chute's. For finding the index of refraction of water (and other liquids) as outlined in experiment No. 40 of Chute's Laboratory Guide to Physics. A rectangular metal tank, 10x6x4 cm., with parallel sealed-in sides of glass..... **$4.00**

597K. Refraction Plate, Hall's. Glass plate, 7x7 cm. by 10 mm. thick. Two opposite edges polished, the other two ground. For determining the index of refraction of glass **$0.50**

602K. Screen, Woden, Apertured. 30x15 cm. Mounted vertically on a wood base and provided with an aperture 5 cm. square. As used in Carhart and Chute's Course in the study of images formed by small aperture **$1.25**

603K. Screen, Wooden, Plain. Same as No. 602K, but without aperture **$1.25**

Spectrometers and Spectroscopes



No. 607K.

607K. Spectrometer, New Student's Model (Gaertner). By a change in construction the graduated surfaces of the circle and verniers are brought into the same plane. This new feature allows full illumination without shadows—making reading easier. The graduated surfaces further are protected against dust, scratching and corrosion by being completely covered with a snug-fitting cap. Two glass windows in this cap expose the graduated circle and verniers to view.

Smooth, free and easy rotation with accurate concentricity is provided by the large fine-fitting, precision center bearings of steel and bronze. Collimator and telescope are firmly mounted in new double-type cradles with screws for vertical and horizontal adjustment. The slit—6 mm. long—is formed by ground and polished jaws operated by a fine adjusting screw and spring. The telescope is fitted with Gauss eyepiece and a new delicate focusing mechanism. A tangent screw for turning the telescope through a small arc by slow motion is also provided. Both telescope and collimator are equipped with 25 mm. aperture achromatic objectives of 160 mm. focal length.

The brass prism table, 80 mm. diameter, is provided with adjustable spring prism clamp, tilt arrangement and height adjustment. Materials, workmanship, accuracy, optics, and finish considered, this new and improved spectrometer represents the finest value available in this price class.
Without prism **$100.00**

608K. Spectrometer, New Model (Gaertner). Same as No. 607K, but with comparison prism fitted to slit **$107.50**

610K. Prism, Flint, 60 Degree. For above spectrometers. Index about 1.65, height 22.5, side 45 mm., two faces polished **$9.50**

611K. Prism, Flint, 60 Degree. Same as No. 610K, but with three faces polished..... **$23.00**

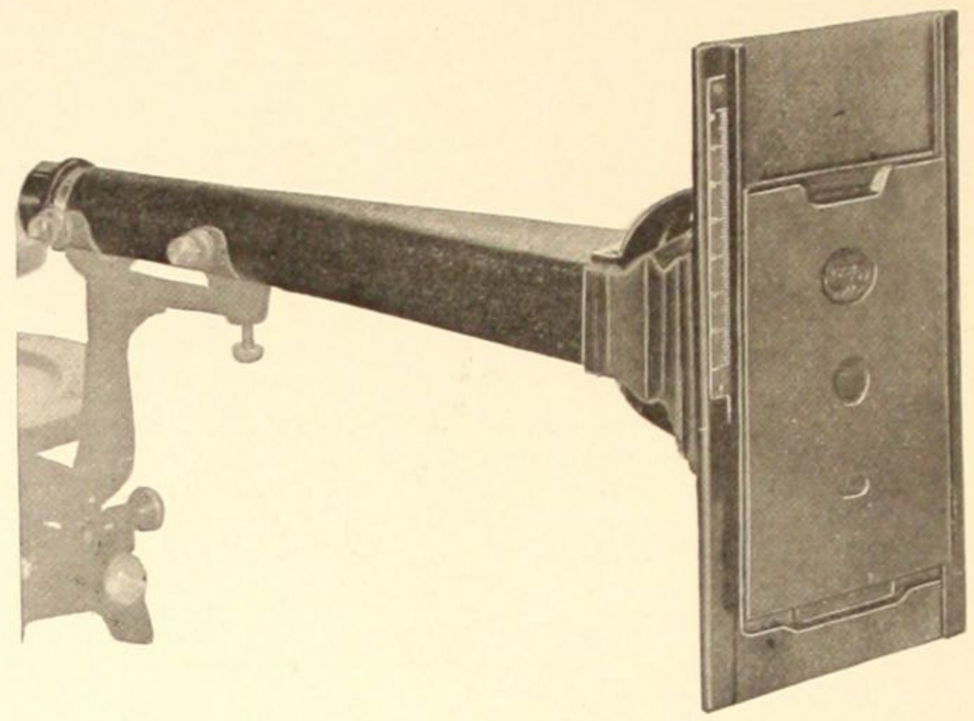
613K. Diffraction Grating. Replica, for direct observation of spectra (transmission grating), 3,940 lines per cm., ruled surface 25x20 mm..... **$4.50**

614K. Diffraction Grating. Replica, 15,000 lines per inch, ruled surface 25x21 mm., ordinary quality. **$4.50**

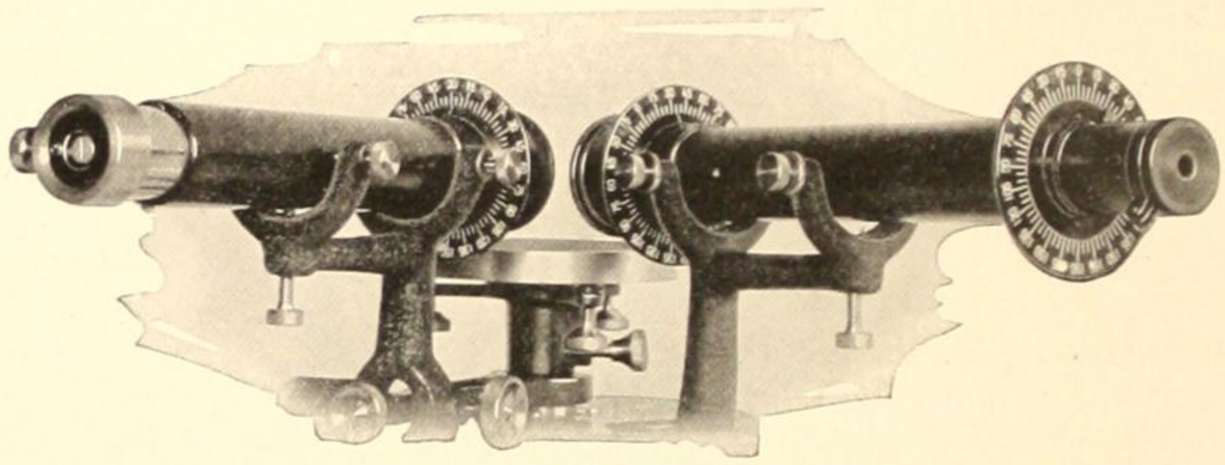
615K. Diffraction Grating. Replica, same as No. 614K, but finest quality **$7.50**

616K. Grating Holder. For clamping above gratings to prism table of Nos. 607K or 608K Spectrometer **$4.00**

Spectrometers and Spectroscopes—Cont.



No. 617K.

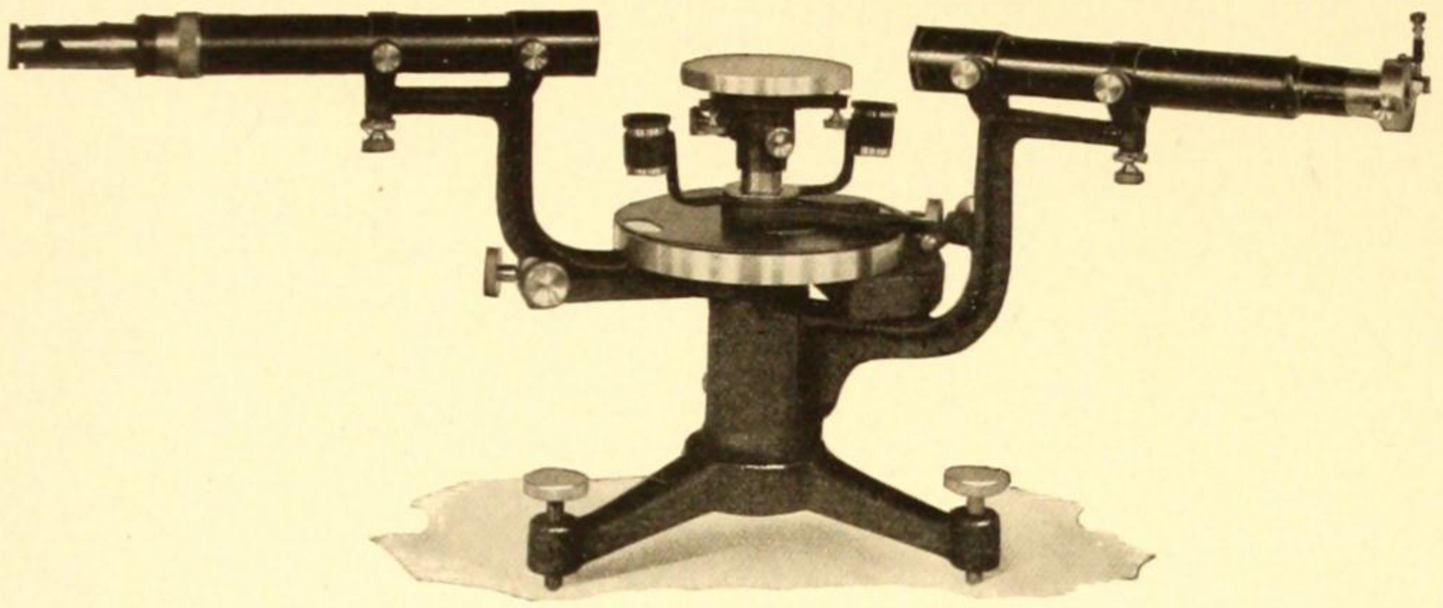


No. 4100K.

617K. Camera Attachment for 607K or 608K Spectrometers (Gaertner). A substantially constructed all-metal camera attachment, designed to fit in place of the observing telescope. It is fitted with an objective of 25 mm. aperture, 300 mm. focal length, mounted in a draw tube graduated in millimeters for convenience in focusing. The plate holder takes a standard size 2½-inch by 3½-inch plate or film and will accommodate at least 15 exposures of spectra. It is arranged to slide vertically in a guide fitted with a millimeter scale for reference. The back plate is joined to the taper body tube by two substantial brackets about which it may be swiveled for adjustment of tilt, a durable leather bellows serving for protection. Complete with one plate holder and focusing screen **$75.00**

4100K. Polarizing Attachments for 607K or 608K Spectrometers (Gaertner). Intended for studying Fresnel's laws of refraction, elliptical polarization by reflection, and by transmission through crystals, etc. Two circles carrying rotable 10 mm. Nicol prisms fit over the telescope and collimator objectives. A third circle at the eye end fits in the place of the usual adapter with cross hairs and carries a special Ramsden eyepiece with a Nicol prism between the lenses. The circles are divided to 5 degrees and permit estimating to single degrees. The Nicol prisms may be rotated independently of the circle for adjustment of zero **$70.00**

Spectrometers and Spectroscopes—Cont.



No. 618K.

618K. Spectrometer, College Grade (Gaertner). A high-grade spectrometer of very latest design and the best workmanship, embodying all conveniences for manipulation, and is specially recommended for spectroscopic work in physical and technical laboratories where a high degree of accuracy is desired.

A new and very important feature from the user's standpoint in the new style spectrometer is the accurate circle graduated on a high precision circular dividing machine, with lines and figures appearing white on a black background. The lines are engraved and white filled by our special recently developed process, rendering them absolutely permanent and by far superior to the old style filler.

The circle is 150 mm. in diameter, accurately graduated to 20 minutes of arc and fitted with two verniers with graduations in the same plane reading to 20 seconds, and is enclosed in a dust-tight housing, readings made from outside through suitable window openings by means of magnifiers. The prism table is of brass, 90 mm. in diameter, fitted with provisions for height and tilt adjustment and rotation independent of the verniers. The prism table and the telescope are fitted with clamping and delicate tangent screw arrangement. The axis is made of selected steel, accurately ground and polished, assuring absolute concentricity. The telescopes and collimator are mounted in double cradles of the support brackets, fitted with all necessary adjusting screws. The brackets are substantially designed and constructed to avoid any possible flexure. The telescope fitted with a Gauss eyepiece and a new improved delicate focusing arrangement giving perfectly smooth motion without shake, is supported on a bracket, counter-balanced by a weight and relieved by a suitable coil spring permitting free rotation. The objectives are achromatic, 30 mm. aperture, 250 mm. focal length. The slit is adjustable for width with jaws of stainless steel 10 mm. long, closing by spring action, consequently eliminating possibility of jamming.

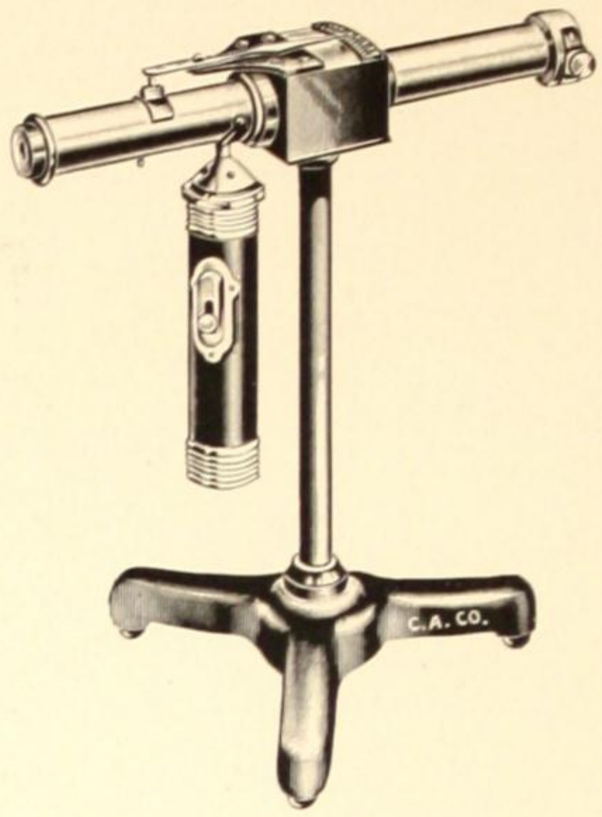
The whole is supported on a substantial, neatly finished tripod, fitted with the new style bakelite head steel leveling screws.....**$275.00**

619K. Prism, Flint, 60 Degree. For use with No. 618K. Index 1.65, faces 54x27 mm., two faces polished **$25.00**

620K. Prism, Flint, 60 Degree. Same as No. 619K, but with three faces polished.....**$32.00**

Note: For Gratings and Holders for use with No. 618K Spectrometer see Nos. 613K, 614K, 615K, and 616K.

Spectrometers and Spectroscopes—Cont.



No. 621K.

621K. Grating Spectroscope with Indicating Scale, Wellesley College Type. Originally designed to meet the requirements of Professor John C. Duncan for use in the laboratory work of his elementary Astronomy classes where their fine performance led us to make them a regular stock item of equipment.

Dispersion is produced by a first quality grating replica having 15,000 lines to the inch. It is mounted between two prisms. The device will locate, separately, each of the D lines of sodium vapor.

The adjustable slit is opened by a thumb screw and closed by spring action, thus protecting it from jamming with resultant damage to the fine edges.

The large achromatic lenses, of one inch diameter, used for the collimating lens and telescope objective, give great light-gathering power with resultant brilliant spectral effects.

The telescope is supported by a light-tight ball joint, with pivots, at the objective end. This arrangement, while light-tight, permits it to swing freely in a horizontal plane so that the entire visible spectrum, from the extreme red to the extreme violet, can be viewed.

The Ramsden Ocular of the telescope is so mounted that the reference wire in the eyepiece can be brought into sharp focus for any eye, while the spectral lines are focused upon independently in the usual way. This allows very sharp focusing of the spectral lines, and also the focusing of the reference wire itself, which greatly increases the accuracy of the readings.

The reference wire is a fine wire stretched in a vertical position at approximately the focus of the ocular. It can be brought into coincidence with any spectral line by moving the telescope, and its position read on the scale.

The pointer attached to the telescope moves along the scale as the telescope swings, and thus gives a numerical reading for any position of the wire.

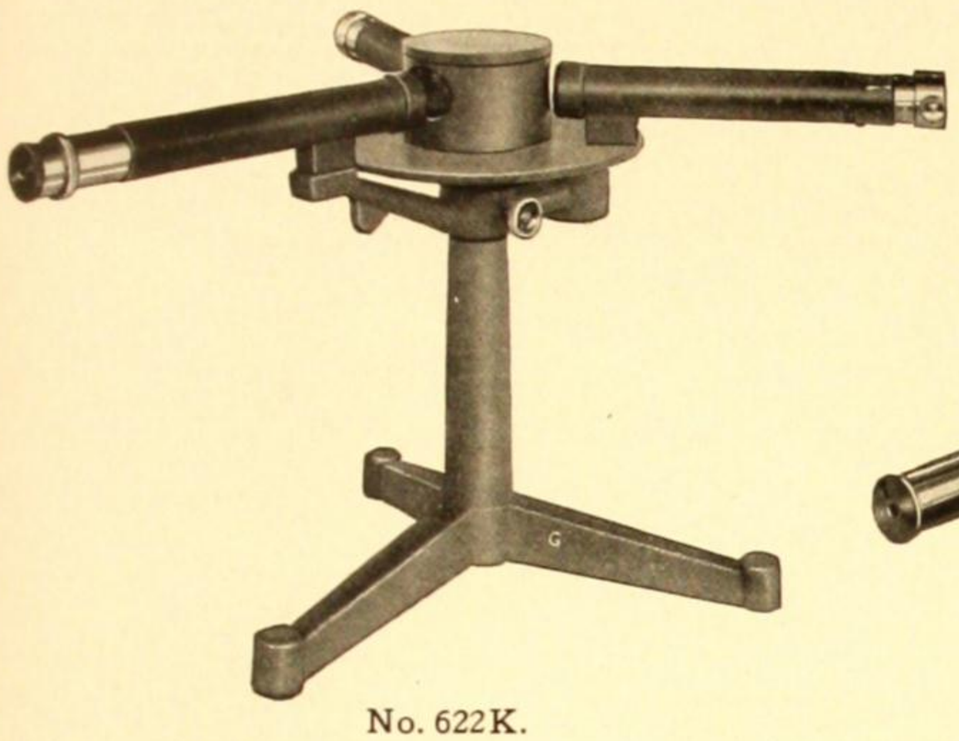
The curved silver scale on top of the prism box is graduated into 50 equal divisions, which may be readily read, by estimation, to tenths. By recording the scale reading of the reference wire for spectral lines of known wave lengths, a calibration curve can be constructed from which the wave length of any spectral line may be readily determined to an accuracy of about 10 Angstroms.

A standard type flashlight attaches to the telescope, by a special adapter, and gives a dim illumination to the vertical reference wire, making it visible when the spectra studies are too faint to impart the necessary visibility. The batteries and lamp may be readily and cheaply replaced. By using a 6 volt lamp, with a 3 volt battery, the desired dimness of illumination is secured, and the life of both lamp and battery very materially lengthened. Holes in the adapter cone show when the lamp is burning needlessly.

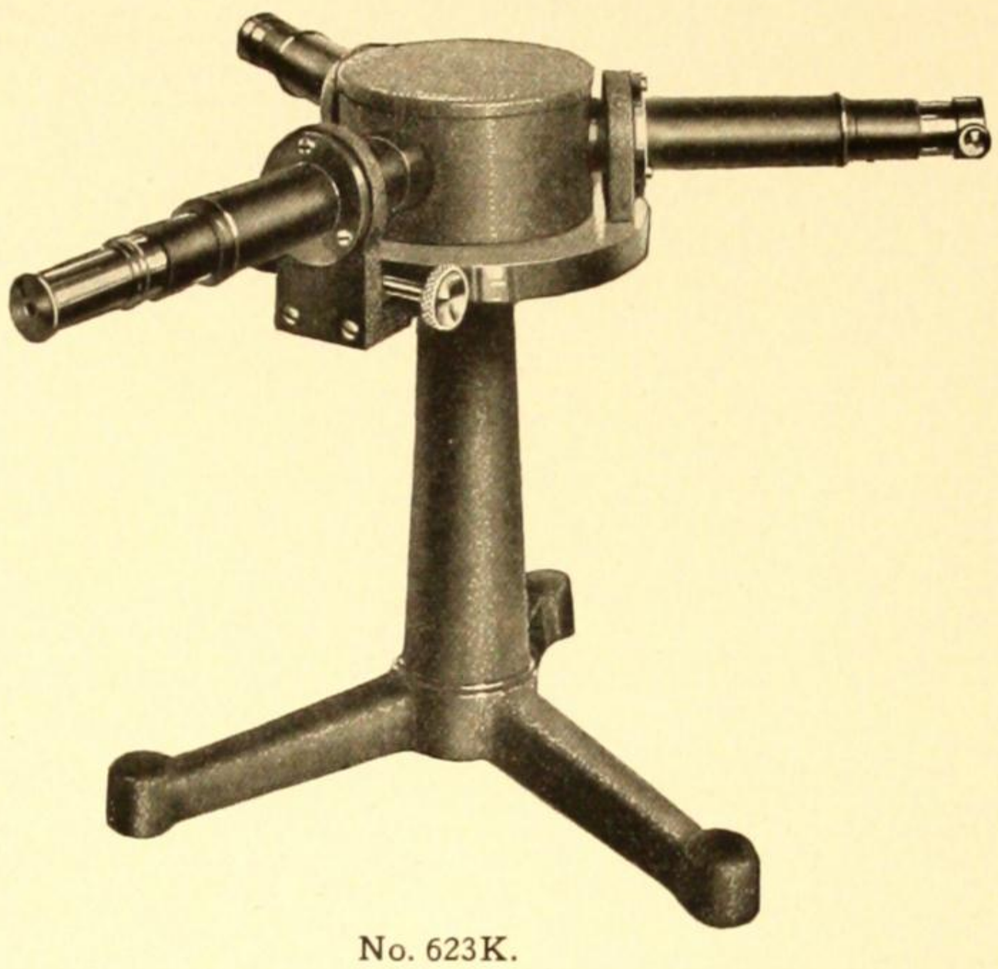
Used for the study of spectral phenomena of all kinds: Arc, flame, vacuum tube, bright and dark line spectra, the solar spectrum and Fraunhofer lines, etc., etc.

The finish is bright lacquered brass for the telescope and collimator and crackle enamel for the rest of the instrument..... **$45.00**

Spectrometers and Spectroscopes—Cont.



No. 622K.

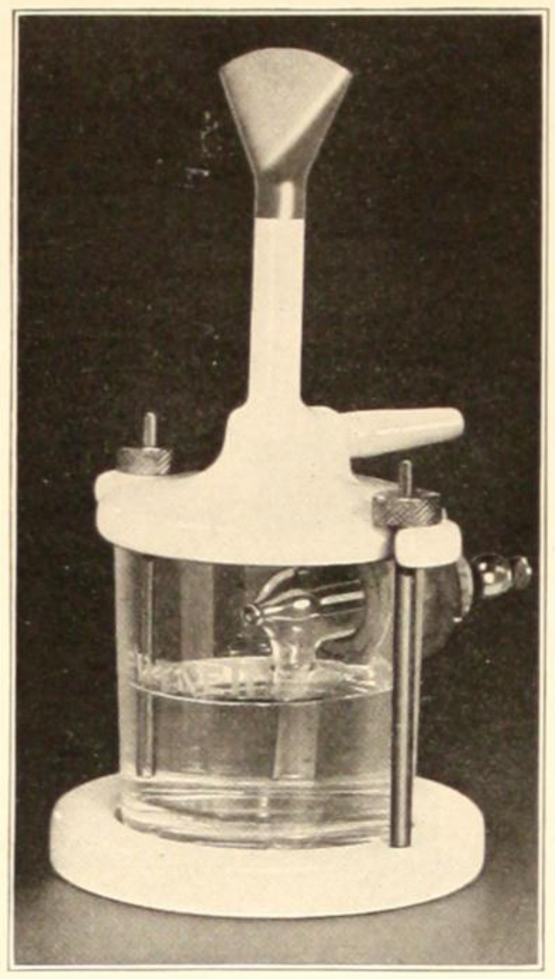


No. 623K.

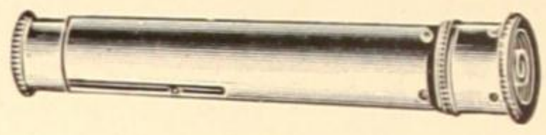
622K. Spectroscope, Students' (Gaertner). A well-made spectroscope, giving a brilliant spectrum of ample length, good definition, specially suitable for students' use for studying the absorption and line spectra of various elements. The collimator and telescope lenses are achromatic, 18 mm. aperture and about 125 mm. focal length, fitted with a draw tube focusing arrangement. The slit with jaws of nickel silver 10 mm. long, carefully ground and polished, closing by spring tension, consequently eliminating any danger of jamming. The scale tube carries a numbered millimeter scale divided in tenths and is focusable adjacent to the spectrum. The 60° prism, made of flint glass with faces 30 mm. x 18 mm., is mounted on a prism table provided with the necessary leveling screws and the whole is protected by a suitable housing with a removable top. The collimator and the scale tube are rigidly screwed on to an enameled iron disc supported by a neatly finished cast-iron tripod. The telescope is supported on a substantial bracket rotatable by hand about the axis of the instrument and tightened in place by a suitable clamping screw **$50.00**

623K. Spectroscope, College Model (Gaertner). A very desirable instrument for studying the absorption and line spectra of various elements. The collimator and telescope lenses are achromatic, 25 mm. aperture and about 200 mm. focal length, focusable by a draw tube arrangement. The objectives are specially selected as to quality and aperture, giving a spectrum of sufficient intensity and excellent definition. The prism is mounted on a suitable prism table, fitted with leveling screws, is made of high grade flint glass—index = 1.65—with faces 25 mm. x 38 mm., giving a spectrum approximately 23 cm. long from 400 to 800 Mu Mu. The slit is adjustable for width, with jars 10 mm. wide, made of nickel silver carefully ground and polished, closing by a spring tension, consequently eliminating possibility of jamming. The scale tube carries a photographic millimeter scale divided into tenths and focusable adjacent to the spectrum. The collimator and a scale tube are fitted with flanges which are rigidly fastened on to the enameled iron support plate, carried by a substantial, neatly finished, cast-iron tripod. The telescope, securely mounted in a bracket, rotates about the axis of the instrument by means of a tangent screw arrangement. The prism is protected by a substantial prism housing, fitted with a removable top **$85.00**

Spectrometers and Spectroscopes—Cont.



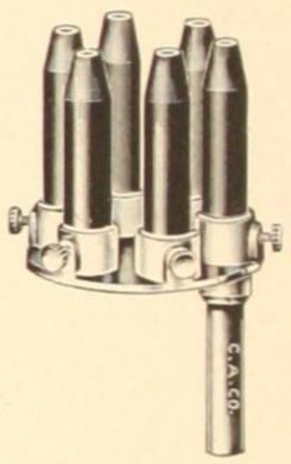
No. 625K.



No. 627K.



No. 632K.



No. 634K.

625K. Monochromatic Flame Burner. A combination of a gas burner and an atomizer specially designed to give a continuous and intense monochromatic light source over a period of several hours. The atomizer, when attached to a supply of air, blows a fine spray of solution in with the gas, giving a bright, broad flame with the color characteristic of the salt used.

The burner and the base are substantial iron castings, PORCELAIN enameled throughout, thereby precluding any possible corrosion due to the action of salt solutions. The clamp rods and nuts are made of Monel Metal, a material highly resistant to corrosion. The heavy glass wall vessel and atomizer can be readily taken out for cleaning. All glass parts are standardized and replaceable.

It is of a very simple construction and requires no elaborate manipulation or adjustments.....**$7.00**

627K. Spectroscope. Direct vision, pocket form. For use in spectrum analysis work. This instrument is provided with a combination of three prisms which give a considerable dispersion. It will show many of the Frauenhofer lines, the bright lines of the metals and gases, and the absorption bands in colored gases, crystals or liquids. Provided with achromatic lens and adjustable slit operated by means of a small micrometer screw. Length, about 10 cm. **$13.50**

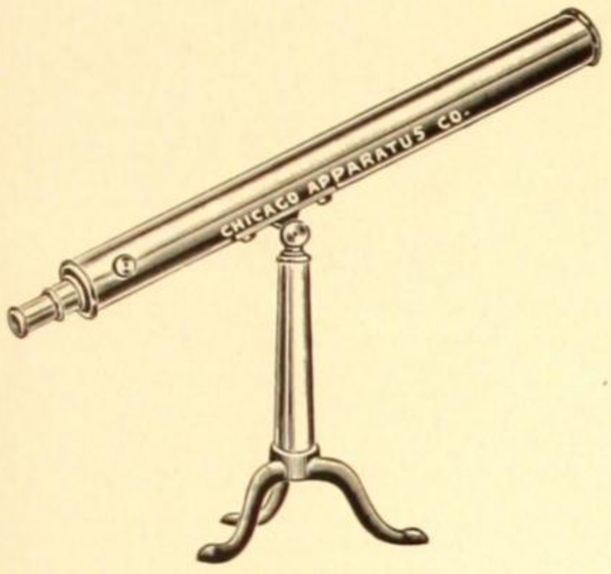
632K. Spectrum Screen. As used in Linebarger's Course, for analyzing, by means of No. 560K, Glass Prism, direct, transmitted and reflected sunlight. Consists of a blackened metal screen with three slots of different widths, and a row of six different colors. Size, 12.5x12.5 cm. **$1.00**

634K. Spectral Apparatus, Mann's. For the projection of the spectra of the metals Sodium, Potassium, Lithium, Barium, Calcium and Strontium in succession upon a screen. Consists of a metal revolving holder carrying six impregnated carbons as illustrated. For use with ordinary 90° arc lamp....**$9.00**

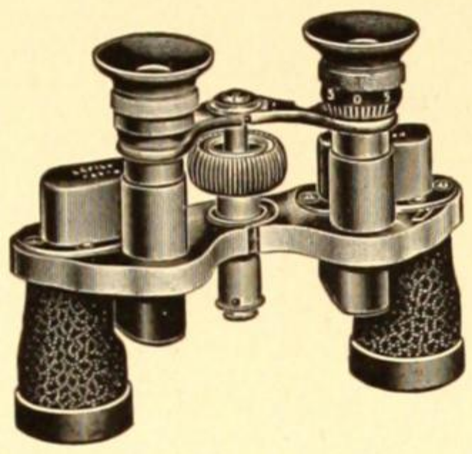
635K. Extra Impregnated Carbons for No. 634K. Per set of six.....**$3.00**



Nos. 663K-666K.



No. 637K.



No. 630B.



No. 640B.



No. 672K.

637K. **Telescope, Astronomical.** This telescope embodies all the qualifications of the high priced models, and with it observations can be made of both terrestrial and celestial objects. The rings of Saturn, the phases of Venus, the satellites of Jupiter and the topography of the Moon can be readily observed and studied with this telescope. Has 40 mm. objective, 25X terrestrial eye-piece and a 50X celestial eye-piece. White enameled body and cap with two draws. Length closed, 16 inches; open, 29½ inches. Complete with a collapsible tripod stand which folds in a wooden carrying case.....**$35.00**

638K. **Telescope, Astronomical.** Has achromatic lenses corrected for spherical and chromatic aberration. Optically efficient in every detail. White enameled body with single draw; 50 mm. objective; 60X celestial eye-piece and 35X terrestrial eye-piece. Complete with 5 ft. hardwood tripod stand which allows a vertical and horizontal radius, and hardwood carrying case **$60.00**

639K. **Telescope, Astronomical.** Brass finished body with rack and pinion focusing device, 75 mm. objective, one 70 and one 150X celestial eye-piece, and one 50X terrestrial eye-piece. Equipped with extra achromatic finder for locating celestial bodies. Length of telescope closed, 45 inches. Complete with oak tripod 66 inches high, allowing a vertical and horizontal adjustment, and hardwood carrying case **$250.00**

640K. **Telescope, Astronomical.** Same as No. 639K, but not equipped with finder.....**$210.00**

663K. **Telescopes, Terrestrial.** Metal body, covered with Morocco, polished brass draw tubes, eyepiece with sliding cover, achromatic objective with cap.

Cat. No.	663K	665K	666K
Power, diameters	15	25	30
Full length, cm.	42	58	74
Closed length, cm.	15	20	25
Diameter of objective, cm.	2.5	3.5	4
Number of sections	4	4	4
Each	**$6.50**	**7.50**	**12.00**

630B. **Binocular Prism.** A highly satisfactory glass for the study of birds and animals. Has unusually large objectives—25 mm. in diameter—giving as a result the greatest illumination and widest possible field. Magnifying power 6X. In fine leather carrying case with shoulder strap **$25.00**

640B. **Bird Glass (Nature Study Glass).** A well-made glass for the study of the Galilean telescope and for observation of birds, etc. Magnifies about 5 diameters (25 times). Price, including a fine leather carrying case with shoulder strap. **Each**.....**$8.00**
Per. Dozen **$72.00**

672K. **Tourmaline Tongs.** For demonstrating that light travels in transverse waves. Tourmaline crystals mounted in revolving eye-piece. When the axes of the crystal are parallel, the light passes through; when crossed the light is entirely cut off.....**$6.50**

Bausch & Lomb Balopticons

The Modern Projection Lanterns

Introductory

While optical projection, in a crude form, was known as far back as 1700, its scientific and universal application is of comparatively recent development. Unappreciated and undeveloped for generations, it has come into its own at last, till today it is an agency of widely known value in the scientific and educational world and in many other fields of usefulness.

A projection lantern is now a recognized necessity in every completely equipped school, lecture hall and auditorium. Since there are models that project either lantern slides, micro slides, opaque objects, or all their range of usefulness is very wide.

Construction

The bodies of Balopticons are of sheet metal, stamped out by special forming tools, making a light but durable instrument. They are finished with a dull black lacquer thoroughly baked in a high temperature oven. The treatment produces a rich, black finish which is both serviceable and appropriate.

Illuminants

There are a number of different illuminants that can be utilized to supply light for projection purposes: the gas-filled Mazdas, the most recently and highly developed; the hand-feed arc lamp; and the acetylene burner. Wherever possible, we recommend that a Mazda lamp be used, for such a lamp is the most convenient to operate and gives the best results. The 6-volt lamp, for use with a storage battery, makes possible the use of a Mazda lamp even where electricity is not available.

Optical Parts

The condensing lenses play an important part in the optical system of any projection apparatus, as the uniformity of illuminating and the size of the illuminated field are dependent on the purity of the glass they are made from and on the correctness of their focal length. The condensing system furnished with Balopticons shown in this catalog is a double system, consisting of two plano convex lenses with the convex sides facing each other.

Improvements on the optical parts of Balopticons have been in keeping with the mechanical development, as evidenced by Balo projection lenses. These superior objectives are of an entirely new type of construction, particularly well corrected for flatness of field and critical definition.

Size of Picture

In purchasing an apparatus for the projection of either lantern slides or opaque objects a point which should receive careful attention is the selection of an outfit with the correct focal length of lens to meet the specific requirements satisfactorily. The focal length of the projection lens, all other conditions being equal, determines the size of picture on the screen. In selecting an apparatus, therefore, one should determine the distance at which the lantern is to be placed from the screen and the size of picture desired. With these two factors given, the focal length of lens required can readily be determined by reference to one of the tables here given.

We would particularly caution Balopticon users not to make the mistake, too often made when working with a projection lantern, of deciding upon too large a picture. Any picture out of proportion in size to the distance at which it is being viewed appears unnatural and lacking in perspective and is a strain to the eyes of the observer.

Where the regular lighting circuits are available, lamps for 110 volts are ordinarily used. For higher voltages, the 220-volt resistance must be used in series with the lamp, as it has not been found practical to make this type of lamp for high voltage, since that would necessitate the use of a more fragile filament and a larger light source.

The focal lengths here tabulated are those which are listed with some one of the different Balopticons for either lantern slides or opaque objects. The tables give in feet the length of one side (the longer in case of lantern slides) of the screen image to be obtained at the different projection distances and with the different lens foci indicated.

Table 1: For Lantern Slides, 2¾ x3-inch Mat Opening

Distance from Lantern to Screen

Focus of Lens	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	60 ft.	70 ft.	80 ft.
6-inch	7½	10	12½	....	....	....	....	....	....	....	....
8-inch	5½	7½	9½	11¼	13	15	....	....	....	....	....
10-inch	4½	6	7½	9	10½	12	13½	....	....	....	....
12-inch	....	5	6¼	7½	8¾	10	11¼	12½	15	....	....
15-inch	....	4	5	6	7	8	9	10	12	14	16½
18-inch	....	....	....	5	5¾	6½	7½	8¼	10	11½	13

Example—A 10-inch lens used at a distance of 40 feet from the screen will project an image measuring 12 feet on its longer side.

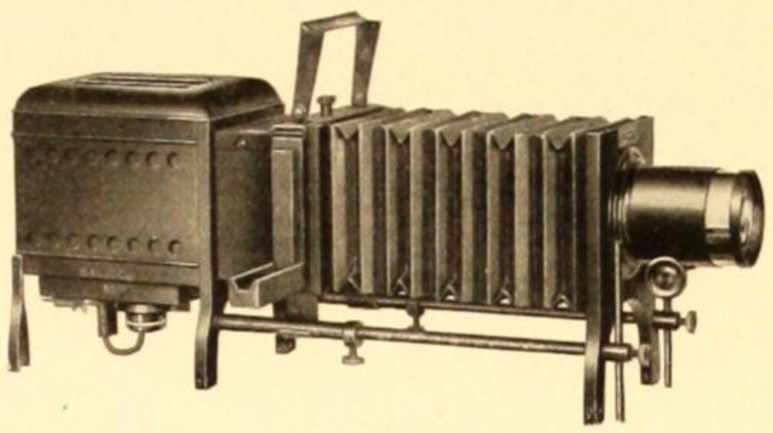
Table 2: For Opaque Objects, 6x6-inch Opening

Distance from Lantern to Screen

Focus of Lens	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.
15-inch	5½	7½	9½	11½	....	....	....
18-inch	4½	6	8	9½	11	....	....
25-inch	....	4½	5½	6½	8	9	10

For lantern slide projection only the white opaque screens will be found entirely satisfactory. With such a screen the room need be only partially darkened. When projecting opaque objects we strongly recommend the use of an aluminum-coated screen, as that will materially increase the brilliancy of the image. The room in which such an apparatus is used should be totally darkened.

Model B Balopticon



This compact, efficient little instrument met with instant success when placed upon the market a few years ago and has increased in popularity constantly until it is now one of the most widely known for use with lantern slides only in school rooms, small auditoriums, Sunday school rooms, lodges and in the home. Balo projection lenses are supplied with this instrument. The larger diameter lenses are particularly recommended, because of the fact that the illumination is increased approximately 40 per cent over that of the smaller diameter.

A very compact metal case, into which the lantern may be easily placed, is regularly supplied with each equipment, affording an easy means for carrying the instrument and a dustproof cabinet in which to store it when not in use. Also has handle at balance point of projector for easy carrying when not in case.

Specifications

Base—Consists of front and rear metal standards, fitted with elevating device, carried on sliding rods which have extension to accommodate 15-inch lens.

Lamp House—Of sheet metal with special ventilation; measures 6½x7x5 inches with removable top; all illuminants interchangeable in one housing.

Illuminant—Our 400-watt, 110-volt, gas-filled Mazda lamp, 30-volt, 14-ampere Mazda, 6-volt Mazda, or two-jet acetylene burner.

Condensing System—Our regular double system, 4 5/16-inch diameter, in special ventilated mount from which lenses can be easily removed for cleaning.

Slide Carrier—Our double carrier, No. 1375K, with elevating device.

Bellows—Mounted on metal frames which slide in metal ways.

Projecting Lens—Balo lens of 1⅝ or 2 5/16-inch diameter and of focus as listed below.

Dimensions—Length (ready for operation), 22 inches; height, 9¾ inches.

Weight—Complete in case, 13-15 pounds, depending on equipment.

Case—Sheet metal, 7¼x9½x15 inches, lacquered in black; with carrying strap.

With Mazda Lamp

1050K. Model B Balopticon, with 400-watt, 110-volt Mazda lamp, with ground and polished glass reflector; 15 feet extension cord with connecting plug switch; double slide carrier; metal carrying case, and 1⅝-inch diameter, 6-inch focus projection lens in spiral focusing mount **$57.00**

1055K. Same as above, but with 8-inch focus lens **$57.00**

1060K. Same as above, but with 10-inch focus lens **$57.00**

1065K. Same as above, but with 6-inch focus projection lens in rack and pinion focusing mount... **$57.00**

1070K. Same as above, but with 8-inch focus lens **$57.00**

1075K. Same as above, but with 10-inch focus lens **$57.00**

1080K. Same as above, but with 2 5/16-inch diameter, 10-inch focus projection lens in rack and pinion focusing mount **$65.00**

1085K. Same as above, but with 12-inch focus lens **$65.00**

1090K. Same as above, but with 15-inch focus lens **$65.00**

1095K. Model B Balopticon, with 30-volt, 14-ampere (420-watt) Mazda lamp, with ground and polished glass reflector; 4 feet of extension cord with switch and connector; double slide carrier; metal carrying case, and 2 5/16-inch diameter, 10-inch focus projection lens in rack and pinion focusing mount..... **$70.00**

1100K. Same as above, but with 12-inch focus lens **$70.00**

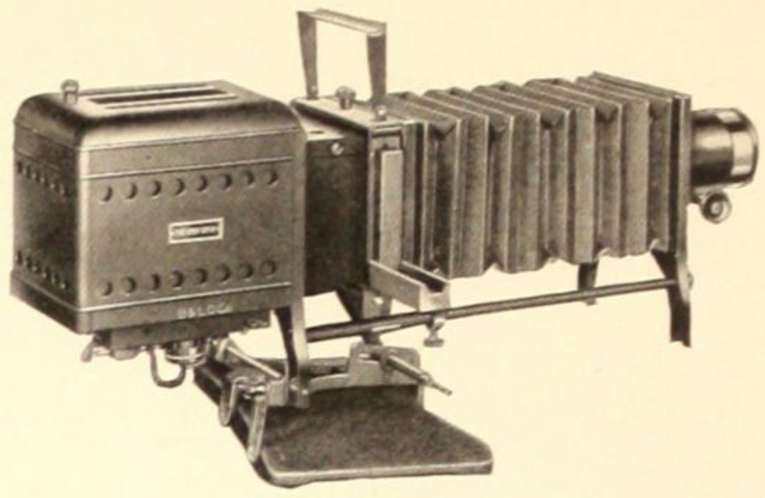
1105K. Same as above, but with 15-inch focus lens **$70.00**

1110K. Model B Balopticon, with 6-volt Mazda lamp with silvered globe, supplementary condenser and six feet of extension cord fitted with switch and connecting lugs for attaching to storage battery; double slide carrier; metal carrying case, and 2 5/16-inch diameter, 10-inch focus projection lens in rack and pinion focusing mount **$63.00**

1115K. Same as above, but with 12-inch focus lens **$63.00**

1120K. Same as above, but with 15-inch focus lens **$63.00**

Model BDT Balopticon with Adjustable Tilting Base



This instrument is the same as the Bausch and Lomb Model B Balopticon, our No. 1050K, and is described on the preceding page with the exception of the improved adjustable base. This new base is of the pedestal type, occupying a space of only 9 by 10 inches, and permitting the lantern to be placed on any small solid support such as a sloping school desk, dictionary, or the bottom of a waste basket. It is adjustable for elevation in two meridians so that the projector may be levelled with the screen, from any uneven support.

Features of this base are its extreme rigidity and ease of adjustment. It is made of heavy cast iron construction of modified rectangular form. The adjustable parts offer a three point support, each firmly attached to the base so that no vibration or lost motion is possible. Both adjustments are controlled by wing nuts, either of which may be operated by one hand while the position of the lantern is fixed by moving the projection lens end of the instrument with the other. It is not necessary to touch the hot lamp house while making adjustments and inasmuch as the front elevating device operates in an inclined slot it is not possible for the lantern to get out of control when the lock nut is loosened. Adjustments for front and side elevation are separate.

This base may be used with the Model B Balopticon in connection with the lantern slide, film slide, or micro projection attachments.

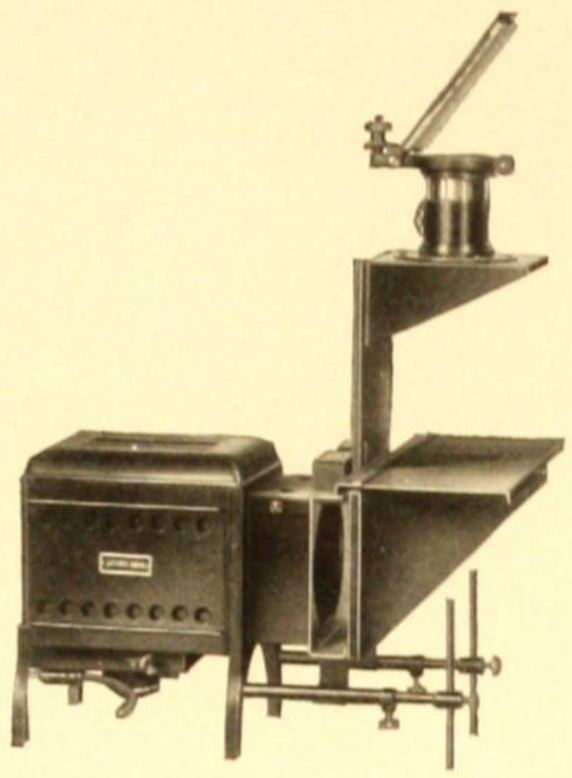
Specifications

See specifications for Model B Balopticon.

Prices

Any of the Model B Balopticons listed may be furnished with this base attached at an extra cost of **$5.00.** In ordering specify the number which you desire. (For example, No. 1050K Model B Balopticon, with BDT adjustable tilting base, would be **$62.50**), and also specify that you wish this Model Number furnished with the BDT base.

The New Overhead Projector



Every user of the Balopticon has undoubtedly, at some time or other, wished that he could face his class or audience and at the same time operate his own projector. This would eliminate annoying waits while slides were being changed by an assistant. He has also, no doubt, wished that the screen could be placed so that each person in the room could see it clearly and easily.

We now offer a new Overhead Projector either as a unit or as an attachment which will fit easily and quickly onto Models B, BDT, CL, CR, KRF, and KRMS Balopticons. This new instrument has several definite advantages:

1. The lecturer can face his audience and at the same time operate his own machine.

2. Changing slides is extremely simple and can be done while talking.

3. Slides are inserted right-side-up. The lecturer sees them exactly as his audience does.

4. Features in the picture to be stressed can be pointed out, with a pencil on the slide, instead of using a pointer on the screen.

5. The screen, being overhead, is easily visible to everyone in the room.

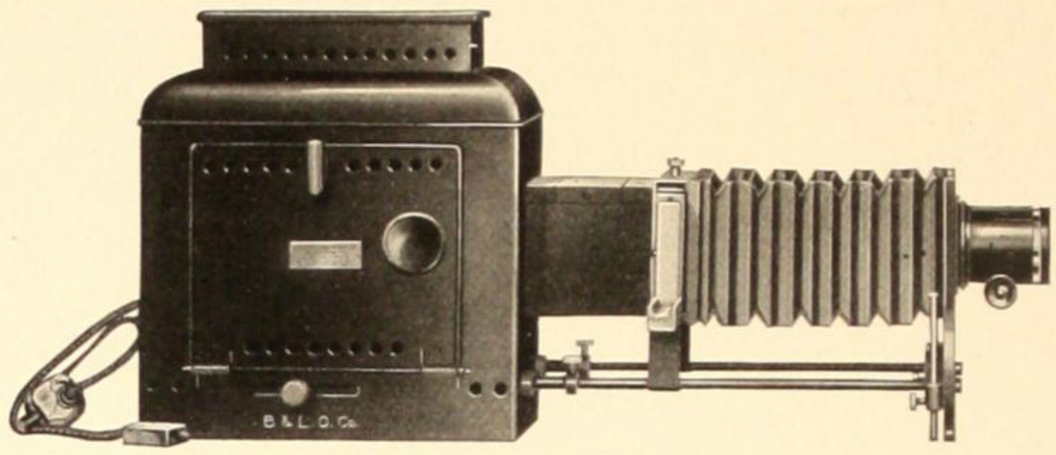
1145K. Overhead Projector. Consisting of lamphouse as furnished with Model B Balopticon, including 500-watt, 115-volt pre-focused base Mazda lamp with glass reflector, 15 feet of extension cord with connecting plug and switch, overhead projector with horizontal table for supporting the slide, 1⅝ inch diameter 7 inch projection lens, and first surface mirror in adjustable mounting, complete in metal carrying case **$75.00**

1148K. Overhead Projector. Consisting of BDT body, including 500-watt, 115-volt pre-focused base Mazda lamp with glass reflector, 15 feet of extension cord with connecting plug and switch, overhead projector with horizontal table for supporting the slide, 1⅝ inch diameter 7 inch focus projection lens, and first surface mirror in adjustable mounting, complete in metal carrying case **$80.00**

1149K. Overhead Projector Attachment. Consisting of upright support with horizontal table for the slide, 1⅝ inch diameter 7 inch focus projection lens and first surface mirror in adjustable mounting **$40.00**

1150K. Screen, White Opaque. 30x40 inches in wooden frame with eyelets for hanging..... **$9.50**

Model CL Balopticon



The Model CL Balopticon, which has been especially designed for lantern slide projection at relatively long distances where large size pictures are required, is an ideal instrument for use in auditoriums or other large rooms where the lantern must necessarily be so placed with reference to the screen.

Ample illumination for pictures up to 12 feet in width is given by the 1000-watt, 110-volt lamp, but for larger size pictures the arc lamp or the low-volt Mazda with resistance is recommended.

A carrying case is not regularly supplied with this equipment, but one can be had as an extra.

Two of these units can be connected, one above the other, and the lenses fitted with an iris diaphragm dissolver or a dissolving switch, making an ideal dissolving view equipment. The two units can be disconnected easily and used alone.

Specifications

Base—Consists of metal feet on bottom of lamp house and front metal standard of one piece with front board, the whole carried on sliding rods; front standard provided with elevating device for tilting instrument as desired.

Lamp House—Measures 13¼ inches long, 14 inches high and 7½ inches wide, light-tight, constructed of double walls with air space between and provided with large, light-tight door on the side—conforms to most rigorous requirements of Boards of Underwriters.

Illuminant—Hand-feed arc lamp for direct or alternating current with adapters for small carbons, 1000-watt, 110-volt, gas-filled Mazda lamp 30-volt, 30-ampere (900-watt) Mazda.

Condensing System—Our regular double system in ventilated mount; diameter, 4½ inches.

Slide Carrier—Double carrier, No. 1375K, with elevating device.

Bellows—Mounted on metal frames which slide in metal ways, with extension sufficient for 18-inch focus lens.

Projection Lens—Balo lens, with rack and pinion adjustment.

Dimensions—Length, extended, 33 inches without lens; height, 14 inches.

Weight—Without case, 25 lbs.

With Arc Lamp

1165K. Model CY Balopticon, with hand-feed arc lamp; double slide carrier; 1⅝-inch diameter, 8-inch focus projection lens in rack and pinion focusing mount **$89.50**

1170K. Same as above, but with 10-inch focus lens **$89.50**

1175K. Same as above, but with 2 5/16-inch diameter, 16-inch focus lens **$97.50**

1180K. Same as above, but with 12-inch focus lens **$97.50**

1185K. Same as above, but with 15-inch focus lens **$97.50**

1190K. Same as above, but with 18-inch focus lens **$97.50**

With Mazda Lamp

1195K. Model CL Balopticon, with 1000-watt, 110-volt, Mazda lamp with ground and polished glass reflector and 2 5/16-inch diameter, 10-inch focus projection lens **$95.00**

1200K. Same as above, but with 12-inch focus lens **$95.00**

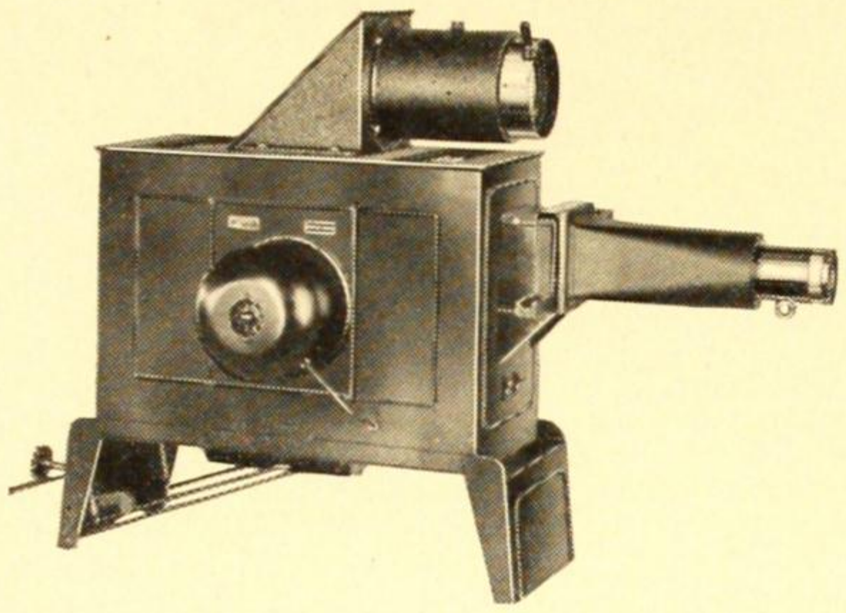
1205K. Same as above, but with 15-inch focus lens **$95.00**

1210K. Same as above, but with 18-inch focus lens **$97.00**

Note—No. 1380K, new quick-changing slide carrier, giving a dissolving effect, may be substituted for $5.00 extra.

Model CR Balopticon

Combined Projector



The new CR Balopticon was designed to meet the increasing demand for a high grade combined projection machine. It is an ideal instrument for school use from both an educational and entertainment standpoint. This Balopticon projects both lantern slides and opaque objects, such as photographs, drawings, maps, postcards, actual specimens and solid objects. It takes the place of the CRM model and incorporates the following features:

The lamp house has been designed to make possible the use of two 500-watt lamps instead of the single 1000-watt lamp which was used in the former CRM. These two lamps are backed by parabolic mirrors and give excellent, even illumination over the entire area of the projected image.

A third 500-watt lamp provides excellent illumination for lantern slide projection. A tumbling switch instantly changes the type of projection from lantern slide to opaque and vice versa.

The lens systems are corrected for flatness of field and critical definition, and the images obtained from both the lantern slide and opaque projection are approximately the same size on the screen.

The upper lens system which is used for opaque projection is adjustable by means of a long spiral aluminum bearing which affords a quick smooth action. The lens has a 25-inch focal length.

The lower lens system which is used for lantern slide projection is adjustable by means of a rack and pinion. This system is equipped with a 12-inch focal length lens.

A motor driven fan at the side of the machine is standard equipment and provides the proper ventilation for keeping the instrument cool.

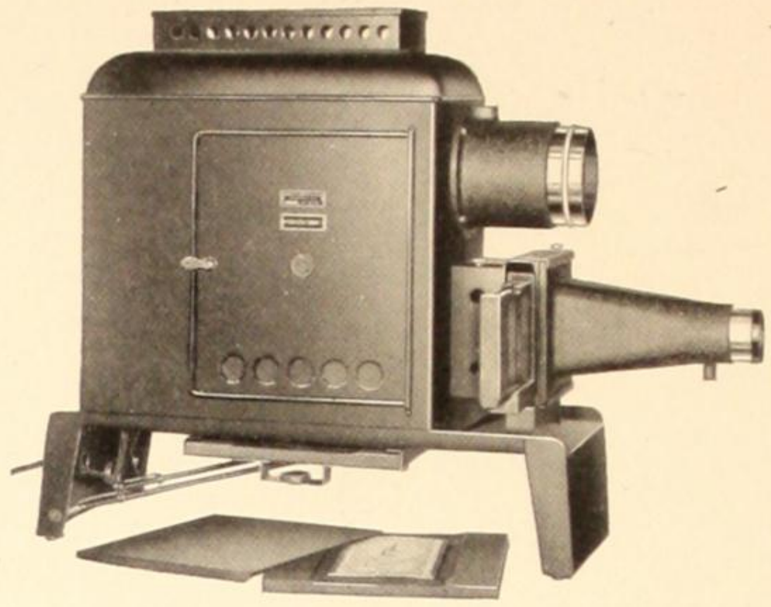
Another new feature which makes for ease of manipulation is a mechanically controlled object holder which raises and lowers the platform upon which the objects are placed. This device will hold the platform in any desired position so that the operator has both hands free to insert or remove the specimen. The opening at the bottom of the lantern takes a 7x8 inch object.

The CR Balopticon is strongly built throughout. Double walls serve to give added strength to the instrument as well as provide a means to keep the outer wall cool.

1226K. Combined Balopticon. For projection of opaque objects and lantern slides with 25-inch focus lens for opaque objects and 12-inch focus lens for lantern slides; three 500-watt Mazda lamps; electric motor driven fan **$290.00**

1231K. Post Card Holder, Extra **2.25**

New Model L R M Combined Balopticon



Model LRM Combined Balopticon. Combined Balopticons (for the projection of both opaque objects and lantern slides) of several different types have been made by the Bausch and Lomb Optical Company for a number of years, and have come to be considered as standard wherever such equipment is required. Their scientific and technical staffs are constantly striving to improve equipment in one respect or another, and details of construction are continually the subject of study and experiment.

It is with considerable pride, therefore, that we offer this new Combined Balopticon, Model LRM, which succeeds the JCRM Model. The latter has been a very popular lantern for a long time, and it was only the possibility of decided improvements that caused it to be discontinued.

Perhaps the most outstanding feature of the new equipment is the amount of light projected upon the screen. With a 115-volt, 500-watt lamp, which can be operated from any ordinary lamp socket, it excels in this respect any lantern with a similar light source ever offered. This has been accomplished by the use of a specially designed glass, parabolic reflector which directs the light uniformly over the entire surface of the opaque object. This reflector is supplemented by chromium plated metal reflectors placed along the sides and in front of the object.

The illumination of opaque objects for satisfactory projection in the classroom and other medium-sized rooms is a problem which has long occupied the attention of many optical engineers. While it is not possible to approach the brilliancy obtained with lantern slides, we are, nevertheless, certain that the LRM Balopticon will appreciably increase the range of usefulness of the opaque projector and will permit its operation under conditions heretofore considered impractical.

Satisfactory projection of opaque objects necessitates the use of a room at least partly darkened. The darker the room, the brighter the picture will appear. It is also true, of course, that for a given room, the smaller the picture the more brilliant it will appear, since the light is concentrated in a smaller area. This new Balopticon will project larger pictures under lighter room conditions than has ever before been possible with a similar light source. In the classroom this is an important factor, in the taking of notes and maintenance of discipline as well as the ability to observe fine detail in the picture without eyestrain.

Another noteworthy feature of the LRM is the improved quality of the lens for opaque projection. By virtue of Bausch and Lomb having their own optical glass-plant they are able to develop glass that will meet the theoretical requirements of their lens designers, and the result in this instance is a lens having unusual flatness of field, critical definition and high-light transmission. It is, moreover, mounted in a very substantial and smooth-working spiral focusing mount.

A lens 3½ inches in diameter and of 14-inch focal length is supplied for opaque projection and one of $1\frac{5}{16}$ inches diameter and 7-inch focal length for lantern slide projection. These focal lengths were selected to make it possible to use the Balopticon within a relatively short distance from the screen so that the speaker would be able to operate it and still be at the front of the group.

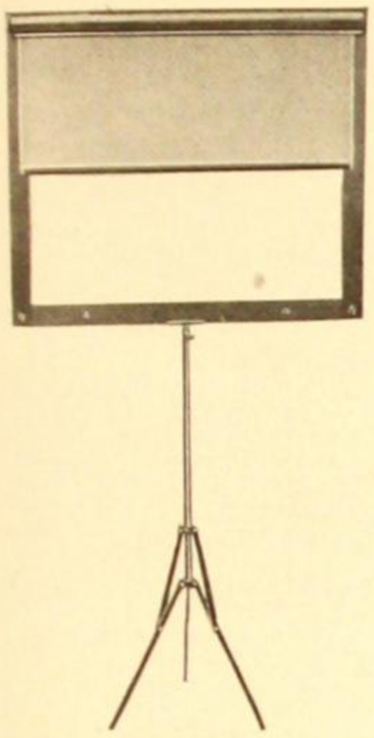
At fourteen feet from the screen, a picture 6 feet wide will be projected and will be increased or decreased in size accordingly as the distance is increased or decreased. The smaller the screen image the brighter will be the illumination. In a thoroughly darkened room and using an aluminum coated screen, pictures up to 10 feet in width may be projected with satisfactory illumination. The better the quality of the object picture as regards contrast, sharpness of outline, reflecting surface, etc., the better will be the resulting screen image.

Subjects up to 6 inches square can be projected at one time, although objects of much larger size can be placed in the object holder, which is near the center of a 14-inch space. Two postcard holders with ways adjustable from 2¾ up to 4 inches wide are supplied, and a flat plate sliding on the top of the object holder holds loose single sheets or cards against the dark chamber by spring tension.

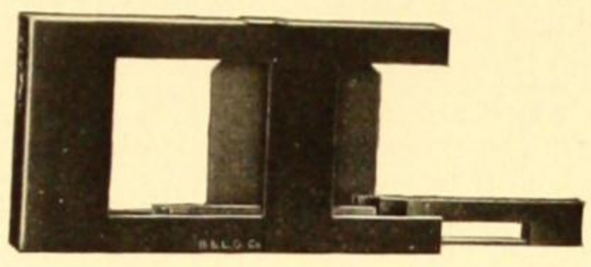
The entire construction of the instrument is rigid and substantial. The dark chamber is well ventilated and does not become too hot for comfortable operation even with long continued use. The instrument is completely finished in a dull black lacquer.

1260K. Combined Balopticon for lantern slides as well as for postcards, photographs, etc., complete with lantern slide accessories, 500-watt, 115-volt, gas-filled Mazda lamp of special design; connecting cord with switch and plug; two adjustable postcard holders and plate for flat objects.....**$110.00**

Balopticon Accessories



No. 1370K.



No. 1380K.



No. 1384K.

1300K. **Cable,** rubber covered twin, No. 12 copper wire, for 15 amperes, **per foot**.....**$0.20**

1305K. **Cable,** rubber covered twin, No. 10 copper wire, for 25 amperes, **per foot**.....**$0.25**

1310K. **Cord,** lamp, rubber covered portable, No. 14, **per foot** **$0.12**

1315K. **Cord,** lamp, rubber covered portable, No. 16, **per foot** **$0.08**

1320K. **Carbons,** cored, $\frac{8}{16}$-inch diameter, 6 inches long, **per ten** **$0.80**

1325K. **Carbons,** cored, $\frac{7}{16}$-inch diameter, 6 inches long, **per ten** **$0.80**

1330K. **Carbons,** cored, $\frac{5}{16}$-inch diameter, 6 inches long, **per ten** **$0.80**

1341Ka. **Mazda Bulb.** 500 Watt **Edison screw type base** Mazda lamp. For use in older style Balopticons made previous to the adoption of the pre-focused bulbs listed below. In ordering, be sure to specify the style of lamp base, pre-focused or screw type **$4.25**

1341Kb. **Mazda Bulb.** 500 Watt **Pre-focused base** Mazda lamp for use in the new style Balopticons. In ordering, be sure to specify the style of lamp base, pre-focused or screw type **$4.50**

1343K. **Bulb Only.** 1000-watt, 110-volt, Mazda lamp **$9.00**

1351K. **Bulb Only.** 14-ampere, 30-volt, Mazda lamp **$6.00**

Cloth and Aluminum Screens

1360K. **Screens,** made of heavy cloth, specially prepared; mounted on spring rollers.

Size, feet	6x6	8x8	10x10	12x12
Each	**$8.75**	**16.50**	**34.00**	**55.00**

1365K. **Screens.** Aluminum, made of heavy material with a metallic surface, mounted on spring rollers. Recommended in all work requiring brilliant illumination.

Size, feet	6x6	8x8	10x10	12x12
Each	**$11.50**	**22.00**	**45.00**	**70.00**

Translucent Screens for Daylight Projection

1370K. **Screens, Translucent, Daylight.** Subjects shown through (the projection lantern is generally placed directly behind the screen) these screens appear clear, sharp and with all their original color, contrast, beauty and detail. Furthermore, the subjects presented may be viewed from a wider angle, without distortion, than is possible with the ordinary screen. Darkened or specially equipped rooms are no longer needed when translucent screens are used, hence their growing popularity. Each screen is provided with a supporting frame and a special demountable metal tripod. This provides portable outfits which can be readily moved from place to place. Made in four sizes as follows:

Size No.	1	2	3	4
Size, inches	24x30	30x36	36x45	48x60
Each	**$22.50**	**30.00**	**40.00**	**55.00**

1375K. **Slide Carrier,** double, for 3¼x4¼-inch slides, with automatic elevating device.....**$2.00**

1380K. **Slide Carrier, New Semi-Dissolving Type.** A double carrier operated entirely from one side. As a new slide is fed forward, the preceding slide is automatically returned and the metal shield which travels with the slide obliterates all movement of the slide on the screen so noticeable in all other double carriers and other types of slide changers. This approximates a dissolving effect, thereby **relieving all eye-strain.** Designed for 3¼x4¼-inch slides **$5.00**

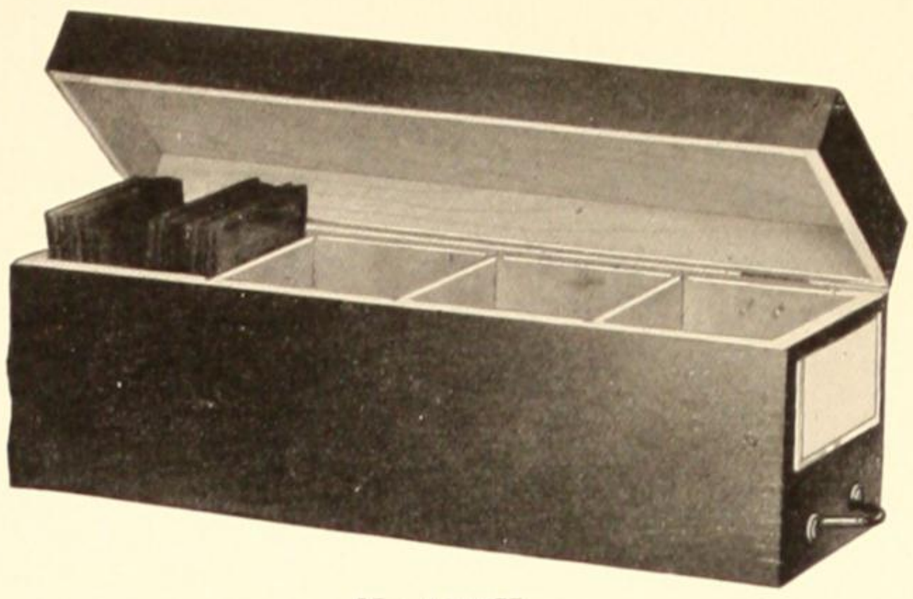
1382K. **Projection Cell, Glass.** For use in connection with a lantern for projecting insects, small fish, worms, leeches, paramecium, etc., upon the screen. May be used dry or filled with water or other liquid. Also suited for the lantern projection of capillary action, crystallization, chemical action, etc. Fits into the slide stage of any lantern designed for the projection of standard lantern slides.

Made of three pieces of glass joined together by an alkali, acid, alcohol, and water resisting cement. Measures 10 cm. high by 12.5 cm. long.....**$4.00**

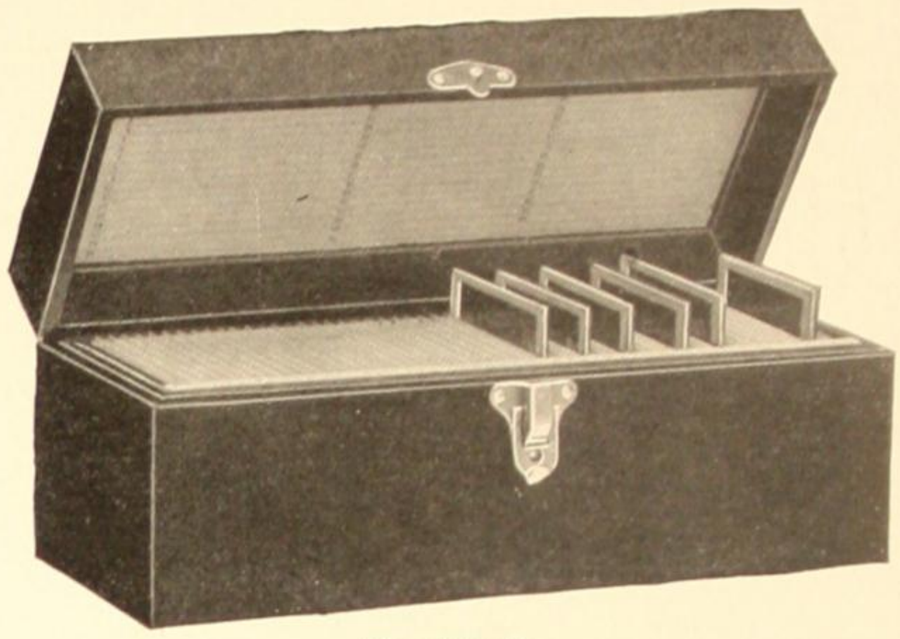
1383K. **Platinum Electrodes.** For use with No. 1382K for showing electrolytic action upon the screen. Each electrode is mounted upon a hard rubber insulating block with binding post. **Per pair**....**$4.00**

1384K. **Electric Projection Cell or Voltameter.** Consists of No. 1382K Cell with pair of No. 1383K Electrodes. Excellent for the demonstration of electrolysis, chemical action and crystallization by the projection lantern method **$8.00**

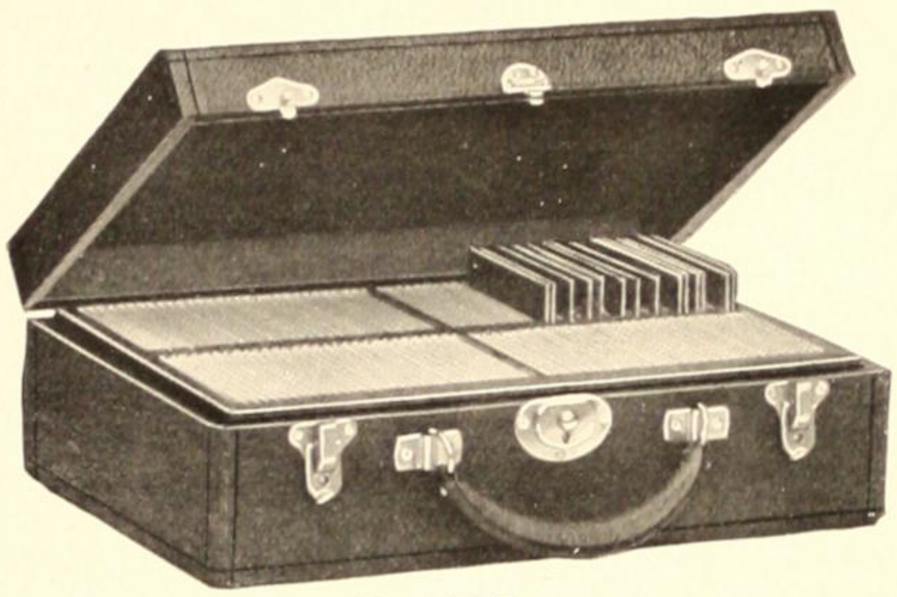
Lantern Slide Boxes



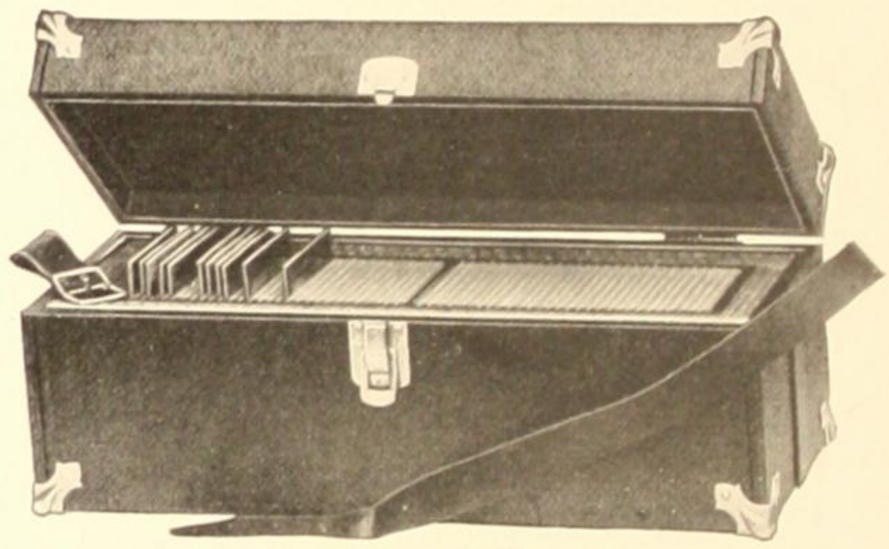
No. 1385K.



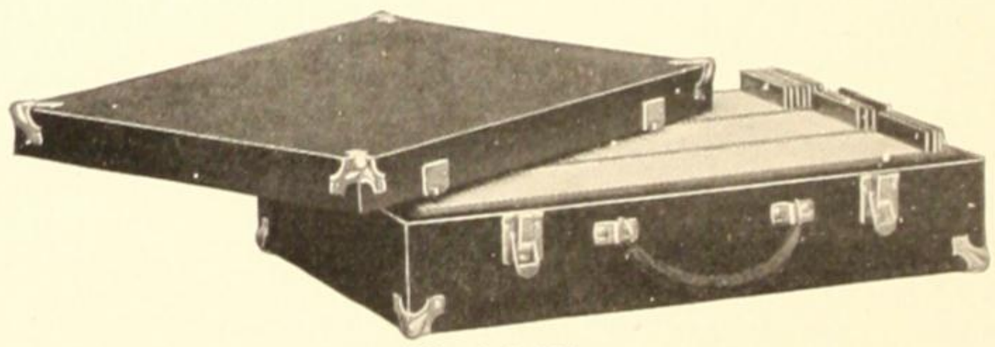
No. 1390K.



No. 1400K.



No. 1405K.



No. 1410K.

The lantern slide boxes listed below are the finest obtainable. They are made of basswood, covered with black book cloth and imitation leather (waterproof and of the best quality), except for the least expensive box which is stained black. The boxes have secure fasteners. These boxes are a necessity in order to keep the stock of lantern slides in order, for storage, and as a means of easily transporting the slides from one room to another or from one building to another, with a minimum danger of breakage. Since they are permanent equipment it will pay to buy only the best.

1385K. Lantern Slide Box, Stock Box. Capacity of 75 to 90 slides, box is stained black, uncovered. . **$1.20**

1390K. Lantern Slide Box. Cloth covered; capacity, 50 slides **$1.75**

1395K. Lantern Slide Box. Same as above except with capacity of 100 slides (two rows of fifty) **$3.00**

1400K. Lantern Slide Box. Capacity, 120 slides. Imitation leather with removable cover..... **$5.00**

1405K. Lantern Slide Box. Capacity, 60 slides. Imitation leather with removable cover. A very high-grade box **$8.00**

1410K. Lantern Slide Box. Capacity, 240 slides. Imitation leather with removable cover..... **$7.50**

Apparatus for Magnetism

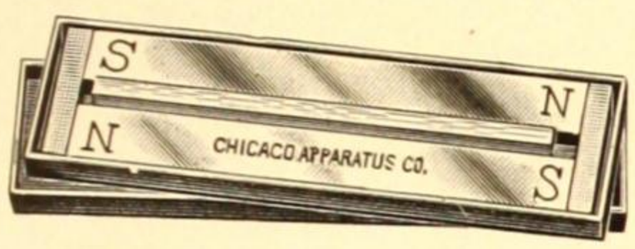
Section M



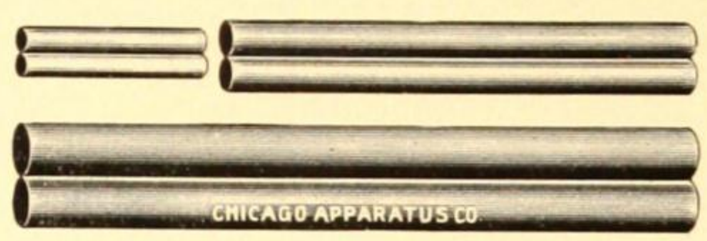
Nos. 13M-15M.



No. 18M-19M.



Nos. 23M-24M.



No. 10M.

8M. Astatic Needle. Two similar magnetic needles, each 15 cm. long, fixed to a short metal tube with agate cap, on stand with pivot. The poles point in opposite directions. This arrangement neutralizes the directive action of the earth and makes this type of needle extremely sensitive.....**$1.50**

13M. Bar Magnets. Steel, black finish, 50x6x6 mm. **$0.15**

14M. Bar Magnets. Steel, black finish, 150x10x10 mm. **$0.25**

15M. Bar Magnets. Steel, black finish, 300x10x10 mm. **$0.75**

18M. Bar Magnets. Steel, polished, 150x19x6 mm. **$0.35**

19M. Bar Magnets. Steel, polished, 200x19x6 mm. **$0.50**

23M. Bar Magnets in Box. Two 150x19x6 mm. No. 18M Magnets in box with keepers.....**$0.80**

24M. Bar Magnets in Box. Two 200x19x6 mm. No. 19M Magnets in box with keepers.....**$1.25**

Cobalt Steel Magnets

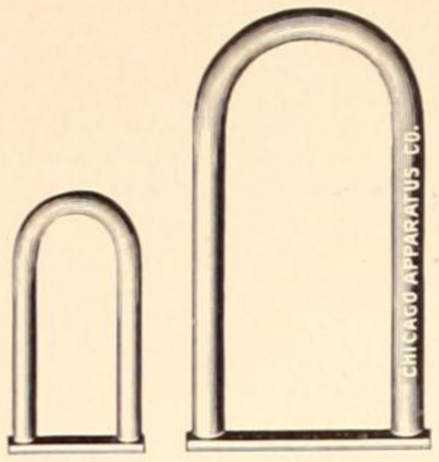
10M. Cylindrical Magnets, Cobalt-Chromium Steel. These new super-strength permanent magnets are made from a cobalt-steel alloy invented by Prof. K. Honda of Tokio University which possesses the remarkable property of having nearly 3.5 times the magnetic retentivity possessed by Tungsten steel, the material from which the best grades of bar magnets are made. Hence, size for size these new magnets have approximately 3.5 times the magnetic strength of ordinary bar magnets. For this reason they will add new force and create new interest in experiments in which they are used. Their poles will attract and hold more iron filings. Likewise they will attract and hold a longer series of iron tacks, brads and small steel balls. They will repel and attract suspended magnets over far greater distances. In induced current demonstrations they will produce far larger galvanometer deflections.

In addition they make possible some strikingly new demonstrations. Thus, if two of these magnets, after having been held side by side with their like poles adjacent, are released on a smooth surface, they will roll 50 to 60 cm. apart, so great is the repelling force. Naturally the attractive force is also very great. This can be shown by holding two magnets 10 cm. apart, parallel and with their unlike poles opposite each other on a smooth surface and then releasing them. They will roll together with considerable display of energy. If one magnet is suspended vertically from the end of a cord about 24 inches long (the cord being attached to the end face of the magnet by means of wax), it will on approach of a second magnet be repelled or attracted over wide arcs. This method is especially suited to demonstration before a large class. If the unlike poles of two magnets are dipped into a tray containing iron tacks, brads, or small steel balls, they will pick up an enormous number which on separation of the magnets to a distance of 4 or 5 inches will arrange themselves in a long chain—making a beautiful demonstration of induced magnetism. Plotting the lines of force about the poles by the iron filings method takes on new interest because of the greater strength of these magnets. Many other startling experiments will suggest themselves to the user, once he has become familiar with the remarkable magnetic strength of these new magnets.

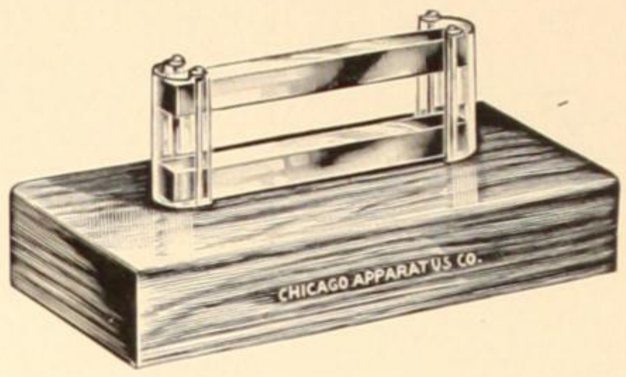
Made in three sizes: small, for individual students' use; medium, for teachers' and advanced students' use; and large for lecture purposes.

Cat. No.	**10Ma**	**10Mb**	**10Mc**
Length, cm.	5	12.5	18
Diameter, mm.	6.5	10	14
Per pair	**$0.35**	**1.35**	**5.00**

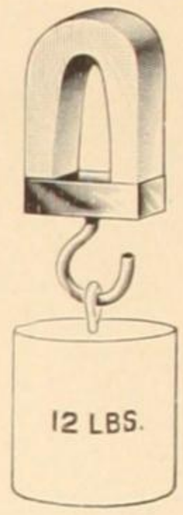
170M. Steel Balls. In certain demonstrations with magnets, especially with the Cobalt-Chromium type like our Nos. 10M and 184M, these small, bright, hardened, polished steel balls are more satisfactory than iron filings. Between strong unlike poles they will arrange themselves in long, continuous chains, which can be readily seen by the class. Diameter, ⅛ inch. In packages of 100 balls. **Per package. $0.25**



No. 184Ma. No. 184Mb.



No. 26M.



No. 89M.

Cobalt Steel Magnets—Cont.

184M. U-Magnets, Cobalt-Chromium Steel, of round cross section. Made from the same cobalt-steel alloy as our No. 10M Cylindrical Magnets, hence possess the same magnetic strength. The small size is suitable for all work in which horseshoe magnets are ordinarily employed; while the large size is suited for all work in which large U-magnets are ordinarily employed. Both, because of their great strength produce striking results and startling effects in all experiments requiring either horseshoe or U-shaped magnets.

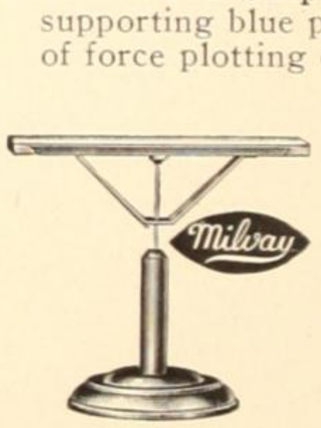
Cat. No.	184Ma	184Mb
Length, cm.	7.5	12.5
Cross-sectional diameter, mm.	6	10
Distance between poles, mm.	25	50
Each	**$0.75**	**1.75**

26M. Wobbly Bar. The design of this device originated in the Research Laboratories of the American Telephone & Telegraph Company. The upper steel bar floats in mid-air in apparent defiance of the laws of gravitation. For this reason, this device has been widely commented upon in newspapers and magazines.

It consists of two cobalt steel magnets, made from the special alloy invented by K. Honda, a Japanese metallurgist. The outstanding property of this new alloy is its remarkably high degree of retentivity. The two magnets are placed between celluloid guides, which permit freedom of movement, and which are mounted on a 5x10 cm. wooden base. The repelling power of these magnets is so great that the upper magnet floats in mid-air approximately ½ an inch above the lower one. If the upper magnet is forced down in contact with the lower, it is instantly driven off when the pressure is released. If one end only is pressed down the other end will retain its elevated position. By removing the two magnets from their mount, their great repelling and attractive powers can be exhibited in other ways. For instance, if they are placed upon a glass plate with their like poles together, they will drive each other apart as soon as the restraining force is released. Again, if they are placed 5 cm. apart, with their unlike poles opposite each other, they will be attracted with great force. If one magnet is held below a glass plate and the other magnet placed above and at right angles to the first, the latter will revolve back and forth until it comes to rest parallel and directly above the lower magnet. One of these small magnets, which measures but 2½ inches in length, will hold a 6 inch bar magnet eight times its own weight—so great is its attractive power. The superior intensity of the field surrounding the poles of these magnets, as compared to the field surrounding the poles of ordinary magnets, can be effectively demonstrated by the induced current method employing an induction coil like our No. 298E connected to a portable Galvanometer like our No. 574E. Other interesting experiments with these highly powerful magnets will readily suggest themselves to the instructor. As illustrated **$3.00**

89M. Cobalt-Chrome Magnet, Horseshoe Type with 12 lb. Lift. A small compact magnet possessing surprising strength. Will support nearly 25 times its own weight—or about 12 lbs. Useful for many laboratory and lecture purposes. Length, exclusive of armature, 45 mm.; poles 25x8 mm.; distance between poles 15 mm.; armature, 25x31x10 mm. The latter is provided with a stout hook..... **$1.25**

25M. Wood Strips. Of Plain wood, 30x1x1 cm. for supporting blue print paper over bar magnet in lines of force plotting experiments. **Per pair**..... **$0.15**



No. 190F.



No. 33M.

190F. Bar Magnet Support. Better and more convenient than the suspended stirrup. The carrier, made of lightweight metal is balanced on a hardened steel pivot mounted in the end of a hard rubber insulating rod. A bar magnet or friction rod resting on this carrier reacts readily to other magnetic or static charges. Will hold any size bar magnet or friction rod. Without bar magnet **$2.50**

28M. Blue Print Paper. For taking prints of magnetic fields. In light-proof packages of 24 sheets.

Cat. No.	28M	29M	30M
Size, inches	4x5	5x7	8x10
Per package	**$0.25**	**.35**	**.50**

33M. Breaking Magnet. Notched for breaking into four pieces. Black finish, 100x6x6 mm..... **$0.25**



No. 38M. (10 mm.)



No. 38M. (25 mm.)



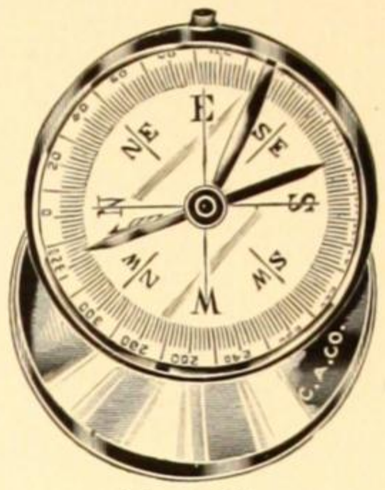
No. 38M. (40 mm.)



No. 38M. (50 mm.)



No. 43M.



No. 45M.



No. 48M.



No. 58M.

38M. Compass, Magnetic. Brass cap needle, brass case, card dial, beveled glass top. All except 10 mm. size are provided with ring.

Diameter, mm.	10	16	25	40	50
Each	**$0.15**	**.18**	**.25**	**.40**	**.55**

43M. Compass, Magnetic. Agate cap needle, brass case, raised card dial with 2° divisions, beveled glass top. Diameter, 45 mm. **$1.00**

45M. Compass, Magnetic. Good grade compass with agate bearing needle, in brass case with beveled glass cover, needle lift lock and slip cover. Silvered dial graduated in 2-degree divisions. Diameter, 40 mm. **$1.10**

48M. Compass, Magnetic. Agate cap needle with 37 mm. aluminum pointer. Brass case, raised dial with 2° divisions, stop for needle. Useful in making galvanoscopes, galvanometers, etc. Diameter, 50 mm. **$1.25**

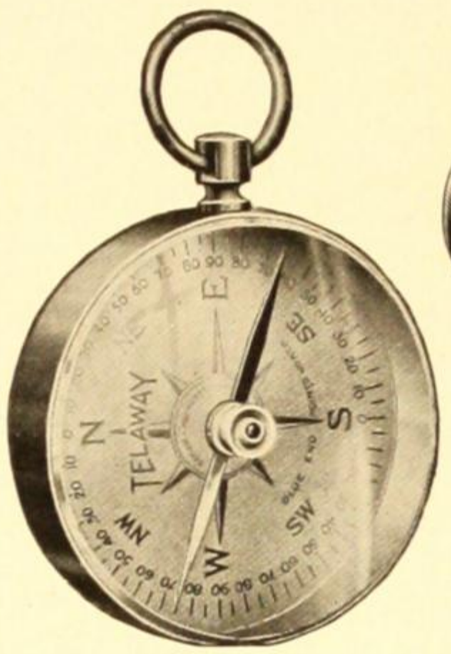
53M. Compass, Magnetic. Agate cap needle. A low-priced but high-grade compass, with dial of enameled card graduated in 5° divisions. The needle is of special steel, heavily magnetized. The case is brass, gunmetal finish, and has a diameter of 40 mm. A heavy beveled glass serves as a cover, making the whole practically dust and water-tight **$0.75**

58M. Compass, Magnetic, Hahn's. A 25 mm. compass mounted on a 35 mm. brass plate with four notches in it. Dial has two black lines on it which pass through the center of the compass at right angles to each other. Beveled glass top, brass cap needle. For tracing lines of force about the poles of a magnet **$0.90**

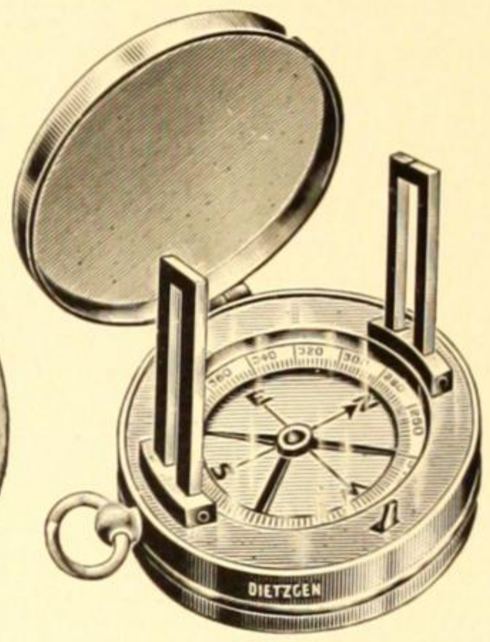
60M. Compass, Magnetic, Sight. A 50 mm. compass with folding sights, one with a vertical hair line, the other with a vertical groove, permit readings to ½ degree. Bar needle, 30 mm. long, with agate cap. A stop locks needle against glass when compass is not in use. Brass dial is graduated in 2° divisions. With hinged cover **$6.00**

63M. Darning Needles. About 7.5 cm. long, 25 in package. **Per package** **$0.25**

68M. Dipping Needle. Delicately mounted needle, 10 cm. long, on brass stand with graduated arc.... **$3.00**



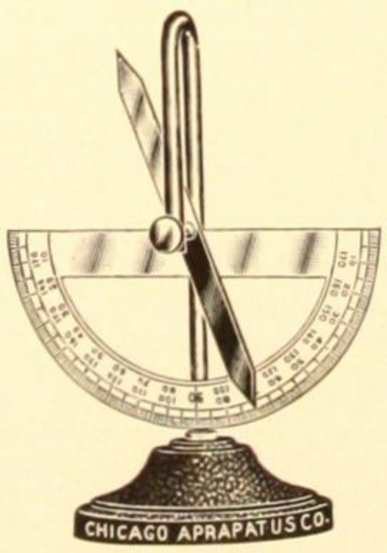
No. 53M.



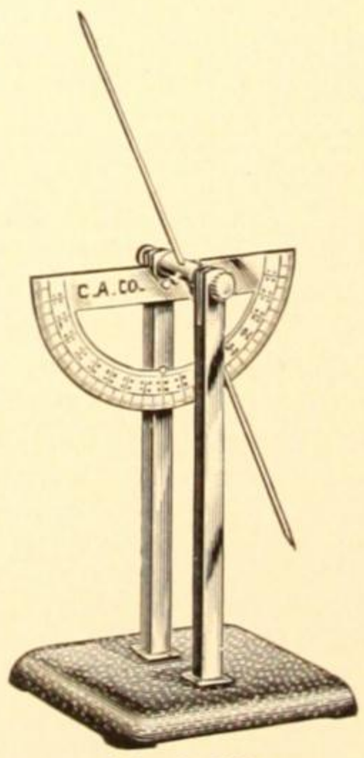
No. 60M.

70M. Dipping Needle, New Milvay Demonstration Form. In use, an unmagnetized steel knitting needle is first balanced in a horizontal position, then magnetized and inclination due to magnetization determined. On stand with graduated arc and pivoted bearings. Complete with twelve knitting needles **$3.50**

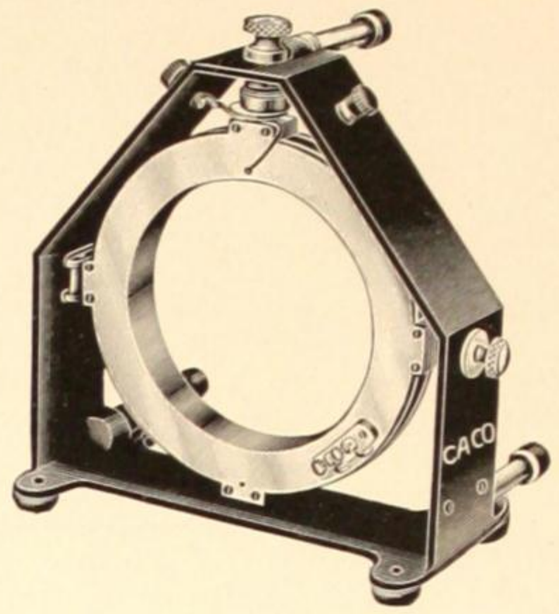
73M. Disc, Magnetic. Steel, 75 mm. diameter. Strongly magnetized to show distribution of magnetism in a disc **$0.50**



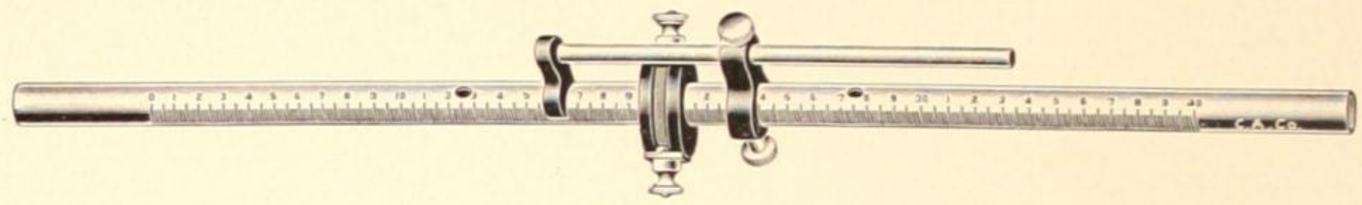
No. 68M.



No. 70M.



No. 75M.



No. 76M.

75M. Earth Inductor with Current Coil, Milvay. For measuring the horizontal (H) and vertical (V) components of the earth's magnetic field by the ballistic galvanometer method. A current coil or secondary winding, consisting of about 50 turns with independent binding post terminals, provides a new and simpler means for determining the current sensitivity or figure of merit (k) of the galvanometer employed.* After the throw resulting from rotation of the coil in the earth's field has been observed, the coil is kept in a fixed position and a current of known value is made to flow through the current coil. The interruption of this current will induce a current in the inductor coil, from the resulting throw of which the constant of the galvanometer can be readily determined. No wood is employed in the construction of this new instrument, consequently warping is impossible. It is made entirely of metal and finely finished. The improved springs, release, and stop employed assure sudden and accurate rotation through 180°. Since the effective area of the coil and the number of the turns in the coil must be known to calculate the final results, such data is given in a plate attached to each instrument.

Specifications

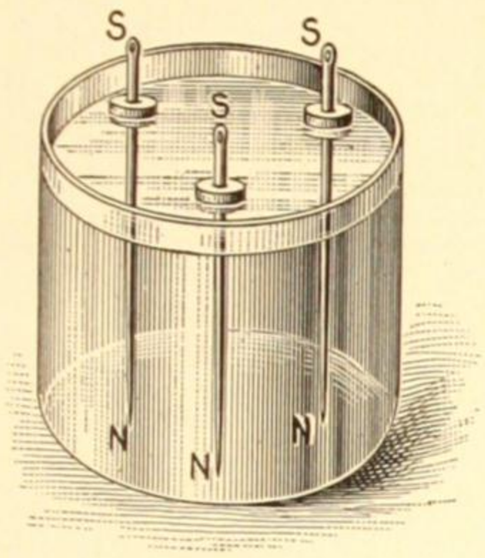
Effective area of the coil, approximately..300 sq. cm.
Number of turns in inductor coil, approximately.1000
Resistance of inductor coil, approximately..410 ohms
Number of turns in current coil, approximately...50
Resistance of current coil, approximately.....1 ohm
Overall height of apparatus.....28 cm.

The apparatus is designed for use with equal ease in either horizontal or vertical position. Spring tension regulator with thumb screw control is provided. From a standpoint of construction, workmanship, appearance and performance, this new MILVAY instrument far excels previous models..**$60.00**

*This improvement is in accordance with suggestions of Prof. A. L. Fitch, Physics Dept., University of Maine, Orono, Me.

76M. Distribution of Magnetism Apparatus, Rowland's. For use, in connection with a ballistic galvanometer (No. 2285E) and a damping key (No. 658E), in the study of the distribution of magnetism in a bar magnet. See Exp. 34, General Physics for the Laboratory by Taylor-Watson-Howe. Consists of a 15x1x1 cm. magnet contained in and at the center of a hollow brass tube, 51 cm. long by 16 mm. in diameter. For convenience in observing the exact points on the graduated tube at which the ends of the magnet lie, and also for measuring the length of the magnet, both ends are exposed through holes in the tubes. The graduated portion is 40 cm. long, divided in mm. and numbered every cm. from 0 to 40.

The movable coil contains exactly 1200 turns, has a resistance of about 160 ohms, is wound on a bakelite bobbin and provided with binding post terminals. To limit its movement for all steps of a test to a definite distance—1 cm. or so—suitable double stops are provided. The arrangement is such that the stops can be shifted along and clamped at any point on the tube without disturbing their distance apart. Since the galvanometer deflections are proportional to the number of lines of force threading the magnet between the two stops, it is evident that by moving the stops along to include all portions of the length of the magnet, the magnetization for each portion may be measured. From the data obtained, a curve may be plotted showing the distribution of magnetism in the magnet, the distance between the poles calculated, and the ratio between this distance and the actual length of the magnet computed. The fine workmanship, elegant finish and accurate graduations in this MILVAY product will appeal to the most critical user of physical instruments **$15.00**



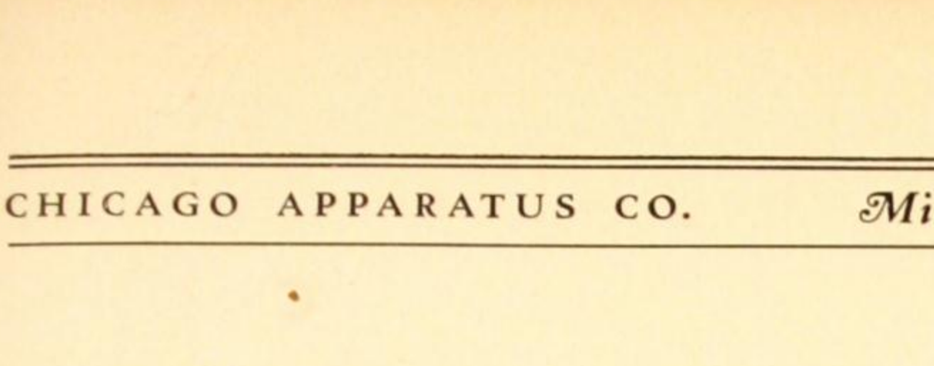
No. 78M.



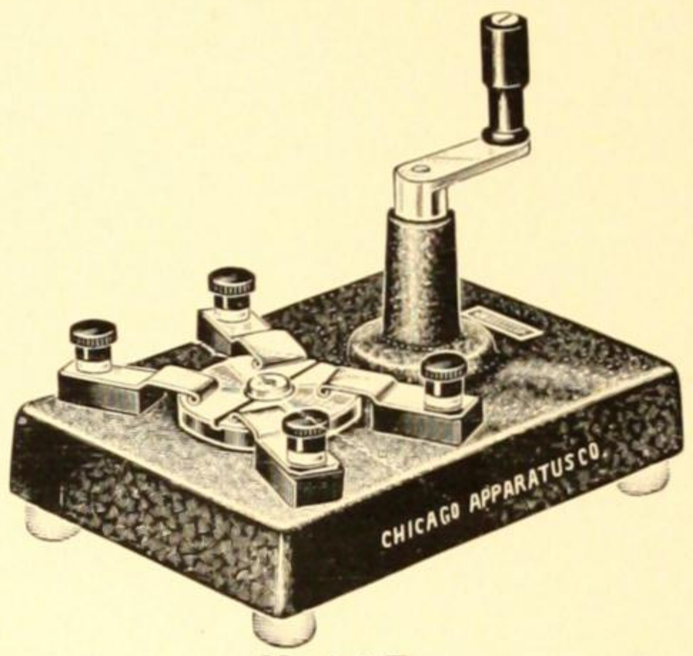
No. 83M.



No. 90M.



No. 92M.



No. 340E.

78M. Floating Magnets. Set of six small magnetized needles with cork floats. **Per set** **$0.30**

83M. Horseshoe Magnets. Best quality, extra heavy. Standard shape, painted red, polished poles, with keeper.

Length, cm.	7.5	10	15
Each	**$0.15**	**.25**	**.40**

88M. Horseshoe Magnet, Compound. Two No. 83M 15 cm. Magnets locked firmly together and furnished with keeper **$2.00**

90M. Hysteresis Coil. Designed to meet the requirements of Experiment No. 15 in Millikan and Mills' "Electricity, Sound and Light." The soft iron ring sample measures 10 cm. inside diameter and has a cross-section diameter of 13 mm. The primary winding is in two layers of about 435 turns each, and the terminals of each layer are brought out to a separate pair of binding posts. Thus either or both layers can be connected into circuit. The secondary or test coil consists of 75 turns of fine wire, the terminals of which are connected to a third pair of binding posts. On finely finished base, 18 cm. diameter **$10.00**

340E. Commutator, Rotary, Milvay—Improved Design. For the complete demagnetization of test samples of iron and steel in magnetization and hysteresis experiments. This commutator is for connection into a test coil circuit through which a battery current (D.C.) is flowing, as outlined in Millikan and Mills' Experiment No. 15. By moving the crank of the commutator the direction of the current is made to undergo a series of rapid alterations. If at the same time the current is gradually decreased to zero, the residual magnetism of the test sample inside of the coil will also be reduced to zero with not predisposition toward a magnetization in any one direction other than that of the magnetizing force.

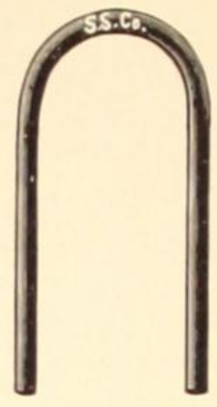
Positive, self-cleaning brush contacts, high commutator speed at ordinary crank speed through easy-working gears, and massive yet simple construction, characterize this Milvay product.

The base, 12.5x17.5 cm., is of cast iron with crystal black finish. The brass parts, except commutator face, are nickel-plated. The gear mechanism in the base is exposed for easy oiling and inspection **$45.00**

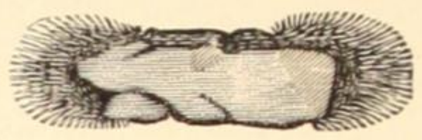
92M. Rheostat, Switch (Gaertner). Designed for use in connection with No. 90M Hysteresis Apparatus, for determining magnetization and hysteresis diagrams of iron as described in Millikan and Mills' Exp. No. 15. The apparatus consists of seventeen carefully wound resistance coils, connected in parallel and controlled by individual knife switches. The resistance of the coils range from 1200 ohms to 10 ohms in such ratios so as to permit adjustment of resistance of any desired magnitude across the bus bar. The resistances are protected by a finished hardwood housing and the whole mounted on a hardwood base. The bus bar is fitted with two binding posts for connections. The approximate resistance of the rheostat with all switches closed is 3.5 ohms. **$50.00**



No. 95M.



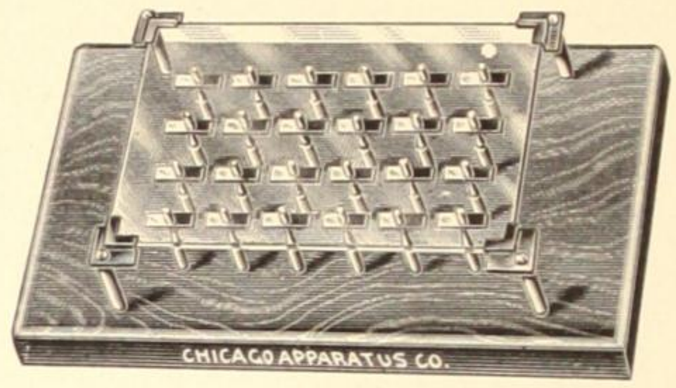
No. 103M.



No. 118M.



No. 128M (Top).



No. 133M.

93M. Iron Filings. Fine, in 4 ounce cartons.
Per carton **$0.15**

94M. Iron Filings. Fine, in 1 lb cartons.
Per carton **$0.30**

95M. Iron Filings. Extra fine quality, 1 lb. in glass jar with sifter top. **Per jar** **$0.45**

98M. Iron Tacks. Small. **Per package** ..... .15

103M. Iron Core. Soft iron, horseshoe shape. As used in Millikan, Gale and Bishop's Course.... **$0.10**

107M. Iron Rod, Soft. Round, 10 cm. long, 6 mm. diameter **$0.10**

108M. Iron Rod, Soft. Round, 15 cm. long, 13 mm. diameter **$0.15**

110M. Pair of Rods. One each of wood and soft iron, 5x¼ inches, for use in the study of the construction of the lectromagnet as outlined in Exp. 57 of Fuller, Brownlee and Baker's Manual.
Per pair **$0.15**

113M. Knitting Needles. Polished steel.
Per dozen **$0.35**

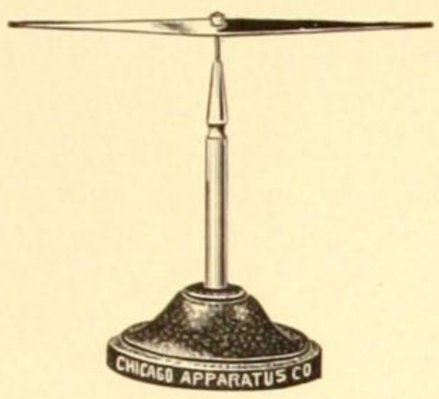
118M. Lodestone. Natural Magnet. Large specimen of magnetic iron ore..... **$0.25**

128M. Magnet Board. As used in Millikan, Gale and Bishop's Course. Made of finely finished wood, 22.5x30 cm. One side is grooved to fit either No. 14M or No. 18M Bar Magnets, the other side to fit No. 183M U Magnet and Keeper..... **$0.75**

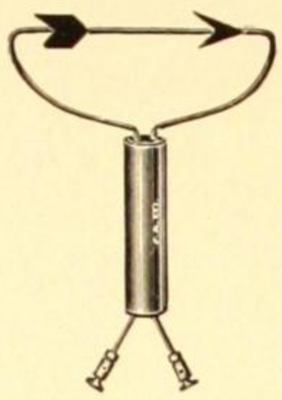
129M. Glass Plate 22.5x30 cm. For use in connection with No. 128M in revealing magnetic fields by the iron filings method **$0.35**

133M. Magnet Model. Milvay. New design. For illustrating the molecular nature of magnetism. Consists of 24 bar-shaped magnets, about 19 mm. long, each on separate pivot, mounted on 15x20 cm. hardwood base. The glass plate is so mounted as to prevent the magnets from falling off their pivots and getting lost; will be found a great convenience in using and storing the apparatus..... **$9.50**

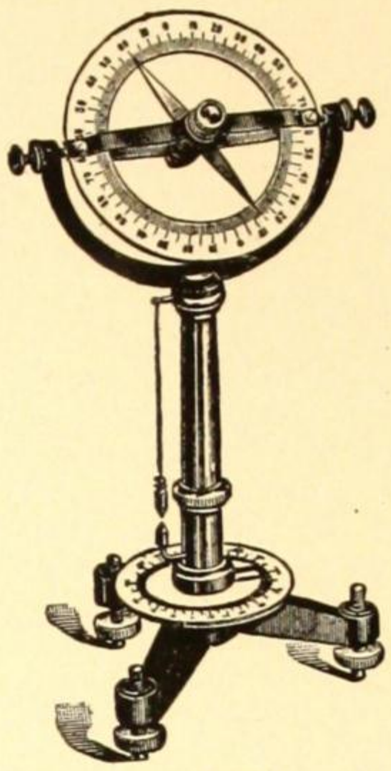
134M. Magnetic Combinations, Lantern Slide Type. Small thin permanent magnets mounted between glass plates, 3¼x4 inches, for use in projection lantern. All poles are plainly marked "N" or "S" and these markings appear clearly in the screen images. When used with a vertical projection attachment, iron filings can be utilized to reveal on the screen the fields surrounding the various combinations: 1. Single magnet; 2. Neighboring north and south poles; 3. Two adjacent north poles; 4. Two adjacent south poles; 5. North and south pole with soft iron piece between them.
Per set of five **$3.50**



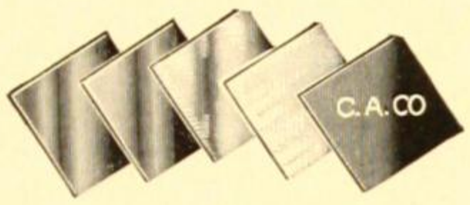
Nos. 138M-143M.



No. 145M.



No. 148M.



No. 150M.



No. 154M.

138M. Magnetic Needle. 15 cm., brass cap, on stand with steel pivot **$0.75**

143M. Magnetic Needle. 15 cm., agate cap, on stand with steel pivot. **$1.25**

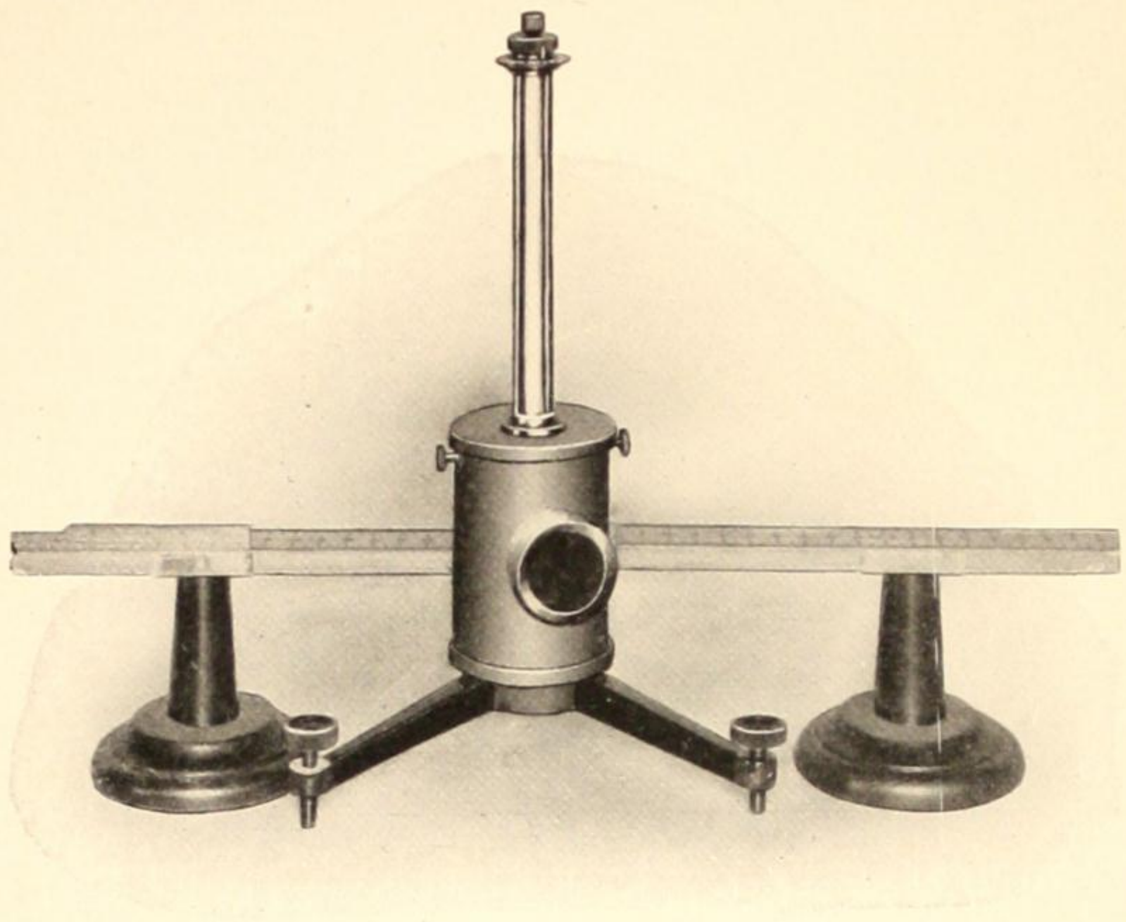
145M. Direction of Current Flow Apparatus. Visualizes the direction of current and is, therefore, valuable in demonstrations with magnetic needles for showing the relation between the direction of the current and the direction of deflection. In use, it is connected into circuit so that the current through it will flow in the direction indicated by the arrow. Has insulating handle and binding post terminals **$3.00**

148M. Magnetic Needle, Declination and Inclination. A first-class instrument of finest finish and workmanship. The magnetic needle, 8.5 cm. long, supported on adjustable agate bearings, is so mounted that it can be brought into any conceivable plane, while the two graduated circles permit of its position being read with accuracy. Both circles are graduated in degrees. Mounted on tripod stand with three leveling screws **$50.00**

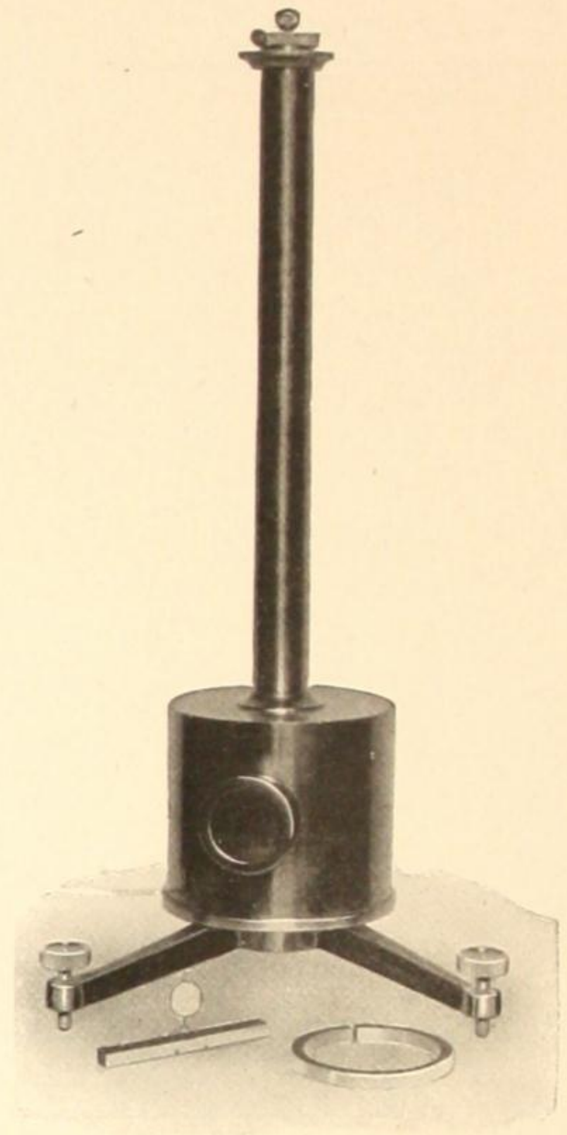
150M. Magnetic Screens. For use in experiments on magnetic transparency. Set contains one sheet each of copper, glass, iron, tin-plate, and zinc, 7.5x7.5 cm. **Per set** **$0.40**

153M. Magnetized Steel Rod. As used in Carhart and Chute's Course. Length 14 cm.; diameter, 3 mm. **$0.15**

154M. Magnetometer, Simple Form. For comparing: (1) field strength of a magnet at different distances, and (2) the magnetic moments of two magnets. Consists of a mahogany finished board with ledge against which magnet under test, slides, and mm. scale reading to 50 cm. both ways from the center. Complete with high-grade jeweled compass, and 15 cm. long bar magnet **$4.00**



No. 155M.



No. 4200M.

155M. Magnetometer (Gaertner). Specially designed for Millikan and Mills' Exp. No. 2, and other similar experiments for determining the horizontal intensity of the earth's magnetic field to a considerable degree of accuracy. The apparatus consists of a non-magnetic, neatly finished, cylindrical housing, fitted with an observation window opening, and an upright suspension tube independently supported by three pillars from the base of the instrument, consequently permitting the removal of the housing without interfering with the suspension. The suspension consists of a specially selected unspun silk fibre, one end of which is permanently attached to a graduated torsion head fitted with index. To the other end, a very light plane mirror with five small magnets is held in a suitable mounting. The apparatus is supported on a substantial brass tripod, fitted with leveling screws and provision for rotating it about the vertical axis. Magnetometer only, without meter sticks or supports.....**$30.00**

156M. Suspension System for No. 155M (Gaertner). For replacement. Consisting of a specially unspun silk thread with mirror held in a suitable mounting carrying five small magnets.....**$4.00**

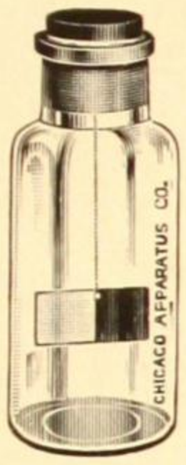
4200M. Magnetometer (Gaertner). The apparatus is somewhat similar to No. 155M, but considerably larger and is intended for determining the MH of the deflection magnet used with No. 155M and for determining the value of H in a different locality by comparison. The suspension system consists of a bar magnet 6 mm. square and 70 mm. long, suspended in a suitable support, with plane mirror and brass inertia ring, the whole suspended by an unspun silk fibre from the graduated torsion head. The brass inertia ring is intended for checking the moment of inertia of the suspended magnet, and is accurately machined so as to permit calculation of its moment of inertia from the geometrical measurements and arranged to fit on the magnet. The cylindrical housing is made of brass, neatly finished and provided with an observation window. The suspension tube is also of brass supported independently of the housing, consequently permitting removal of the housing without interference of the suspension. The whole is supported on a brass tripod, fitted with leveling screws with provision for rotating the apparatus about the vertical axis. Magnetometer, without meter sticks and supports..**$36.00**

4205M. Suspension System for No. 4200M (Gaertner). For replacement. Consisting of a silk fibre with plane mirror held in suitable mounting, also supporting a deflection magnet 6 mm. x 6 mm. x 70 mm., and a brass inertia ring.....**$6.00**

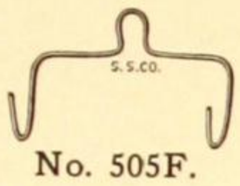
4210M. Magnet for No. 4200M (Gaertner). For replacement. Approximately 6 mm. square and 70 mm. long, carefully machined to facilitate computation of the moment of inertia **$1.00**

4215M. Supports for Meter Sticks (Gaertner). For use with No. 155 M or No. 4200M. Consisting of four neatly finished turned wooden supports fitted with suitable brass clamps for holding meter sticks. For illustration see No. 155M. **Set of four....$6.00**

358M. Meter Stick. Maple, graduated in millimeters and ⅛ inches. Suitable for above apparatus....**$0.35**



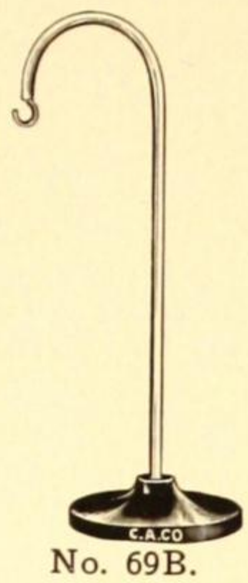
No. 158M.



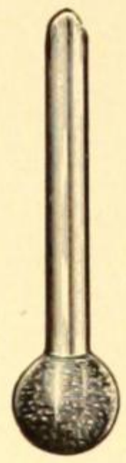
No. 505F.



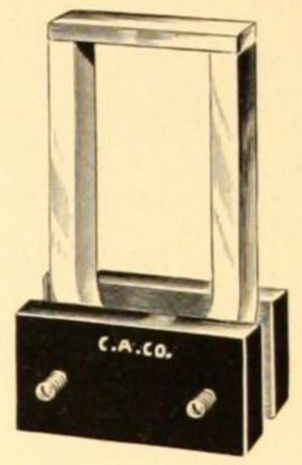
No. 163M.



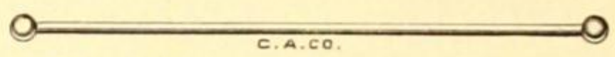
No. 69B.



No. 178M.



Nos. 183M, 185M, and 188M.



No. 159M.

158M. Magnetoscope. Simple bottle form with magnet suspended from stopper **$0.90**

159M. Magnet with Spherical Ends. Robison's. A long, slender, cylindrical rod with hardened and magnetized spheres at the ends. In this form the poles are localized at the center of the spheres, thus simplifying measurement and computation. Polished and chromium plated to prevent corrosion. Overall length, 25 cm. **$0.75**

163M. Sifter. Enameled tin, with screw sifter top; capacity, one pound iron filings. For sprinkling iron filings used in plotting magnetic fields of force. **$0.17**

505F. Stirrup. Of heavy brass wire, 10 cm. long. For supporting bar magnets, friction rods, etc..... **$0.15**

69B. Support. Japanned iron base, curved nickel-plated rod with hook, height 37.5 cm. An excellent support from which to suspend stirrups, pith balls, tin-foiled eggs, hand balances, etc..... **$1.50**

174M. Thumb Tacks. Of polished steel, 10 mm. diameter. In boxes of 100. **Per box**..... **$0.25**

178M. Tube with Iron Filings. For illustrating the molecular nature of magnetism. Glass tube, 10 cm. long, closed at both ends and partially filled with fine iron filings. When the filings are in the tube and the tube is stroked by a magnet, the filings become a magnet temporarily. On shaking up the filings in the bulb and replacing them in the stem, the magnetism will be found to have disappeared.. **$0.60**

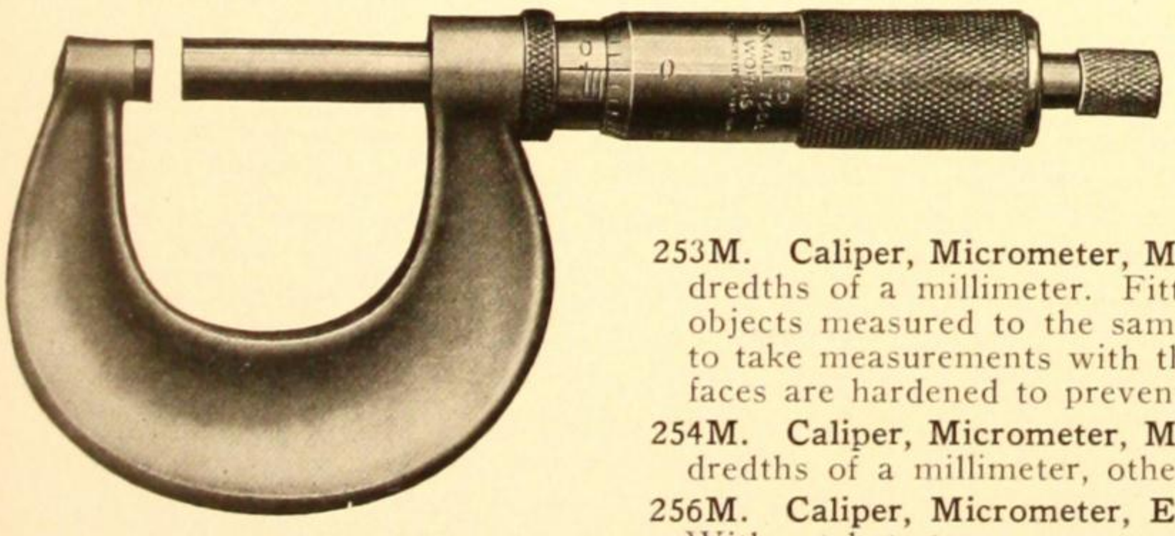
183M. U-Magnet. As used in Millikan, Gale and Bishop's Course. Length, 12.5 cm.; poles, 19x13 mm.; 50 mm. between poles..... **$0.50**

185M. Armature, Soft Iron. For use with No. 183M. Size 75x19x6 mm. **$0.10**

188M. U-Magnet Support. A quick-acting tension clamp for holding No. 183M U-Magnet in a vertical position. Useful in induction experiments.... **$0.65**

Apparatus for Measurements

Section M



Nos. 253M-254M.

253M. Caliper, Micrometer, Metric. Range, 0 to 13 millimeters by hundredths of a millimeter. Fitted with ratchet stop which subjects all objects measured to the same degree of pressure, making it possible to take measurements with the utmost accuracy. The measuring surfaces are hardened to prevent wear..... **$4.25**

254M. Caliper, Micrometer, Metric. Range 0 to 25 millimeters by hundredths of a millimeter, otherwise same as No. 253M..... **$6.00**

256M. Caliper, Micrometer, English. Range, 0 to 1 inch by .001 inch. With ratchet stop **$6.00**

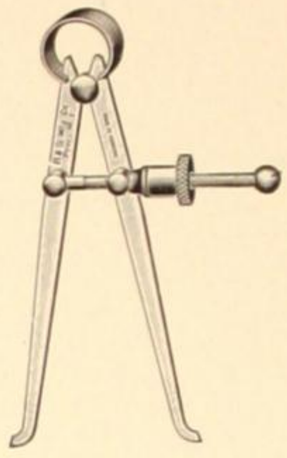
257M. Case for Micrometer Caliper. Morocco leather covered, velvet lined and provided with nickeled snap catch. Will hold either No. 253M, 254M or No. 256M..... **$1.50**



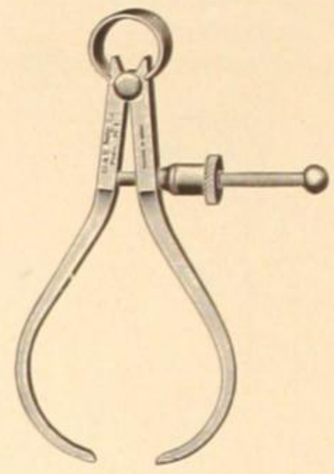
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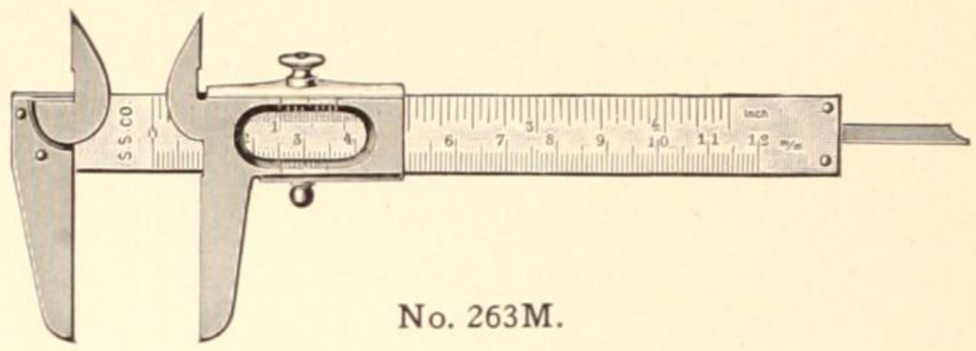
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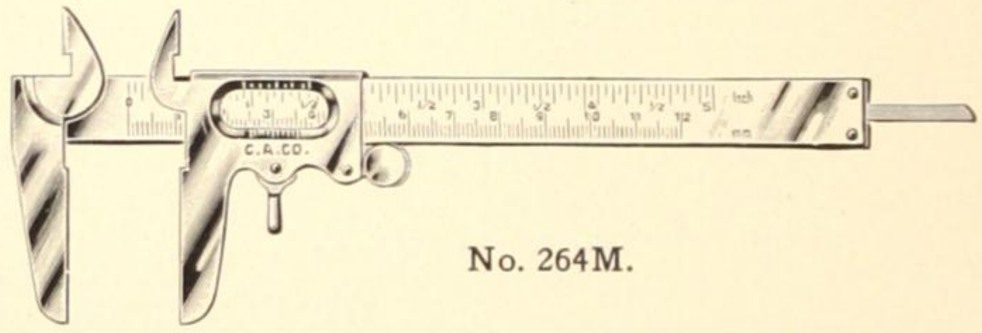
No. 261M.



No. 262M.



No. 263M.



No. 264M.

258M. Caliper, Plain, Inside. Polished steel; length, 15 cm. **$0.35**

259M. Caliper, Plain, Outside. Polished steel; length, 15 cm. **$0.35**

260M. Caliper, Plain, Double. Inside and outside polished steel; length, 15 cm. **$0.50**

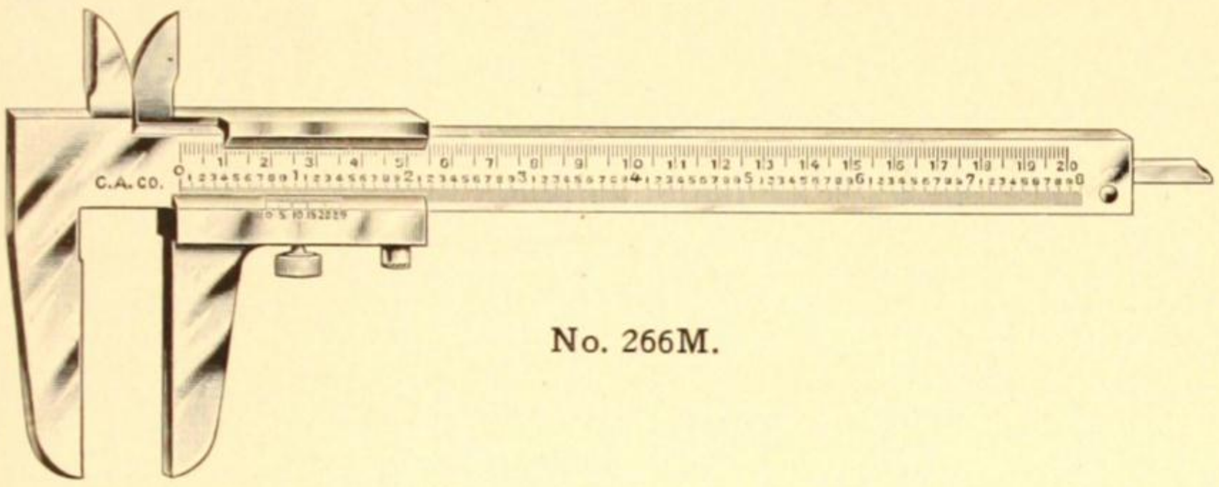
261M. Caliper, Spring, Inside. Polished, tempered flat steel bow spring, with solid nut. Length, 15 cm. **$1.20**

262M. Caliper, Spring, Outside. Polished, tempered flat steel bow spring, with solid nut. Length, 15 cm. **$1.20**

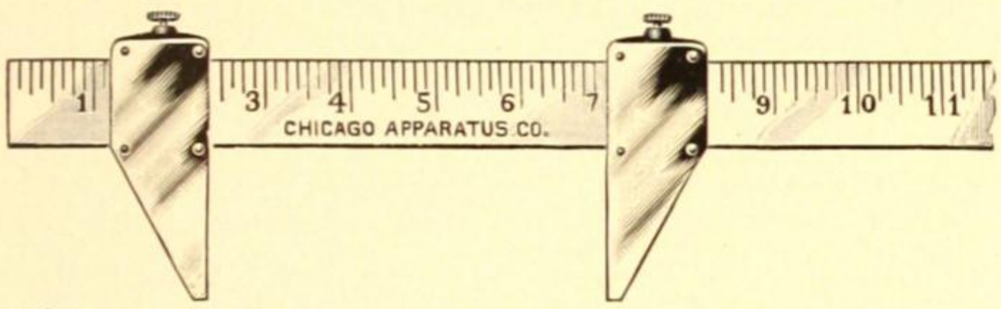
263M. Caliper, Vernier. Inside caliper, outside caliper, and depth gauge combined. The most complete and most practicable caliper yet devised. Ranges—0 to 12 centimeters by millimeters, with vernier by 1/10 millimeters—0 to 5 inches by 16ths, with vernier by 1/128 inches. Provided with thumb attachment for easy operation of the movable jaw. Made of steel, finely polished **$1.75**

264M. Caliper, Vernier, Thumb-Wheel Type. For inside, outside, and depth measurements. The thumb when applied to the small knurled wheel easily moves the sliding jaw in or out, providing a smoothness of movement and a preciseness of control never before realized in calipers of this type. The sliding jaw is also provided with a stop-lock for preventing movement after a measurement has been taken and for preserving a given setting during gauging operations. Has English and metric scales graduated to 5 inches in $\frac{1}{16}$ths, and to 12 cm. in 1 mms., readable by verniers to 1/128ths inch and to 1/10th mm. Of hardened steel, finely nickel plated **$3.00**

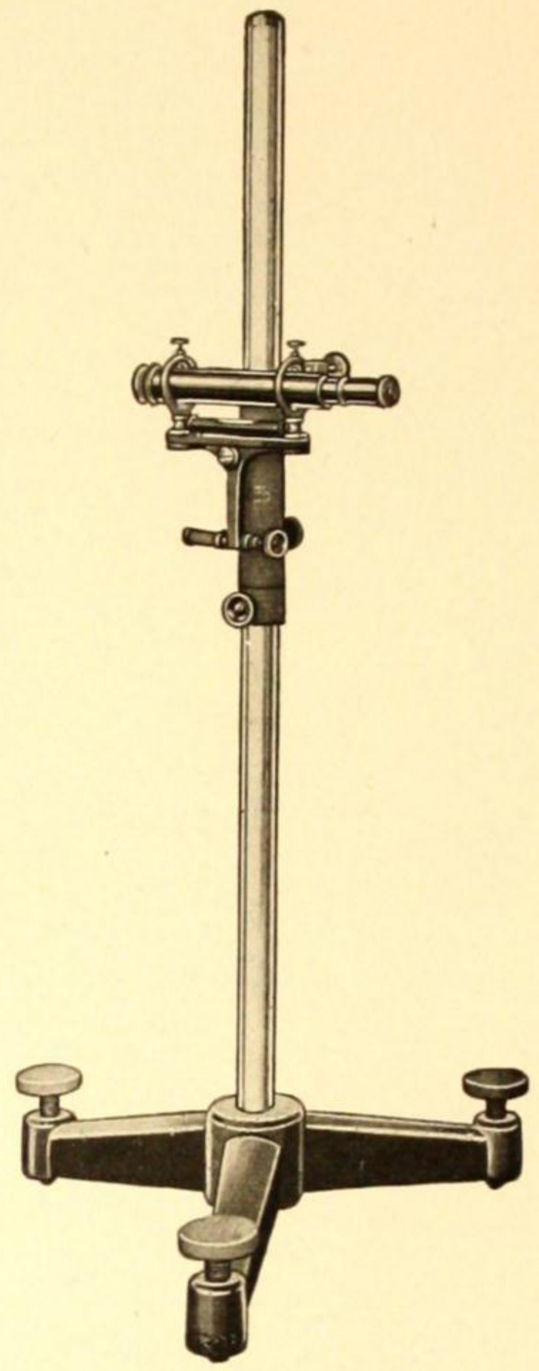
265M. Case for Vernier Calipers. Of leather, will hold either No. 263M or No. 264M **$0.60**



No. 266M.



No. 267M.

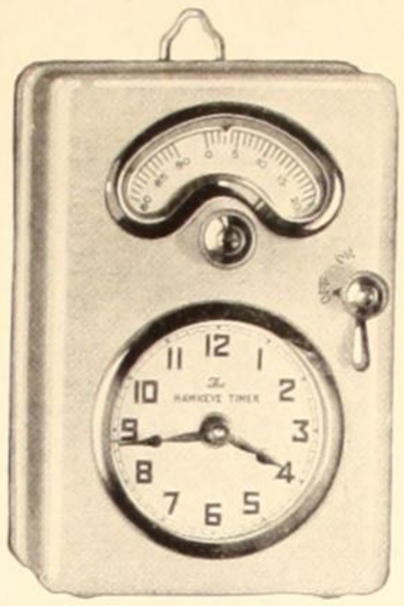


No. 268M.

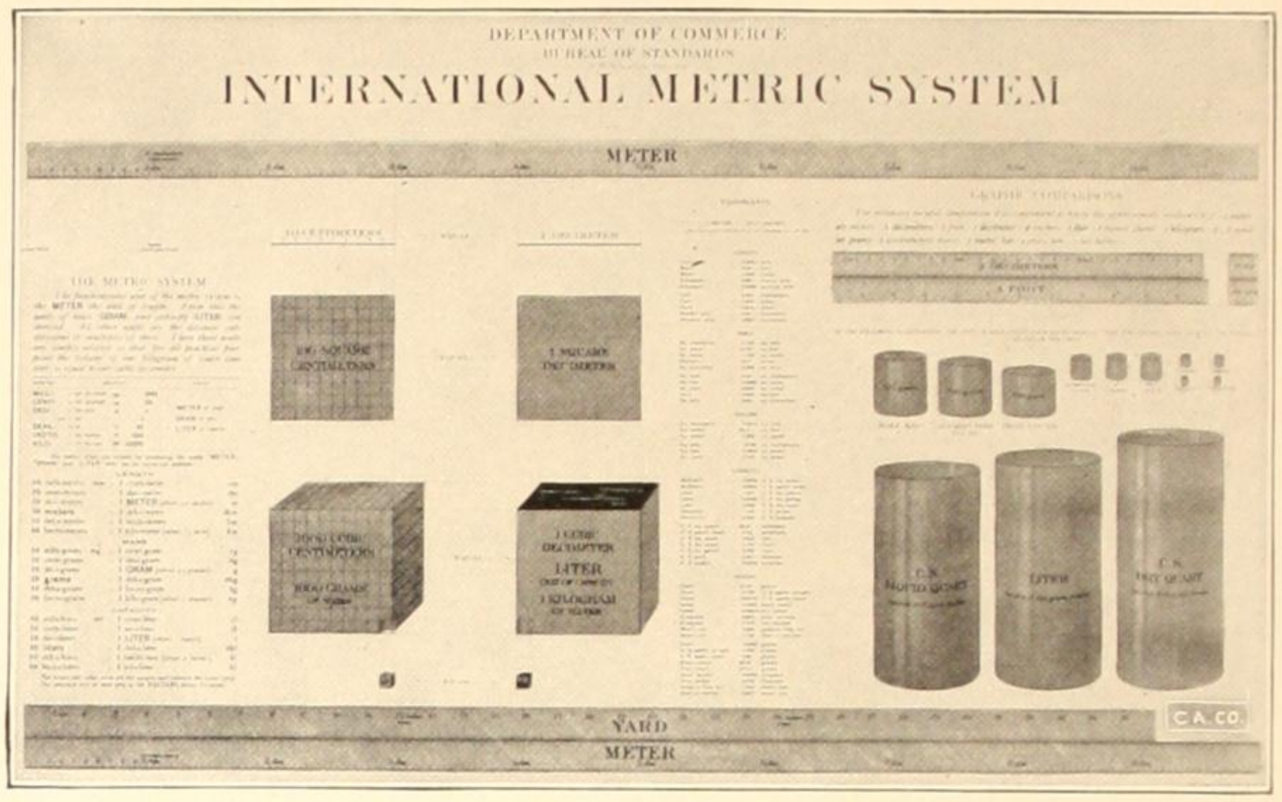
266M. Caliper Vernier, College Grade. Readable to 1/10 of a mm. and 1/1000th of an inch. A combination inside, outside and depth caliper of the finest precision quality. Scales and verniers are engine divided. Jaws and body are 3.4 mm. thick, about twice that of ordinary calipers, and all edges and surfaces are ground to precise dimensions. As a result the movable jaw slides smoothly and easily with complete absence of play. The inner or contact edges of the jaws are true planes exactly normal to the body at all positions. The top scale is 20 cm. long, divided into millimeters, and is readable by means of a 9 mm.—10 division vernier, to 1/10 of a mm. The lower scale is 8 inches long, divided into 1/40-inch divisions, and is readable by means of a 24/40 inch—25 division vernier, to 1/1000th of an inch. The fine construction and extreme precision provides a tool of micrometer accuracy with a range many times that of a micrometer caliper. Made entirely of polished steel and furnished with leatherette protecting case.....**$6.75**

267M. Caliper Jaws. A pair of these jaws and a meter stick (½, 1 or 2 meters in length) makes a caliper that is suitable for measuring the length of linear expansion rods, torsion rods, and other long objects. The steel jaws are securely fastened to clamps that are free to slide along a standard meter stick, and are provided with thumb screws for locking them at any point. Per pair, without meter stick **$2.25**

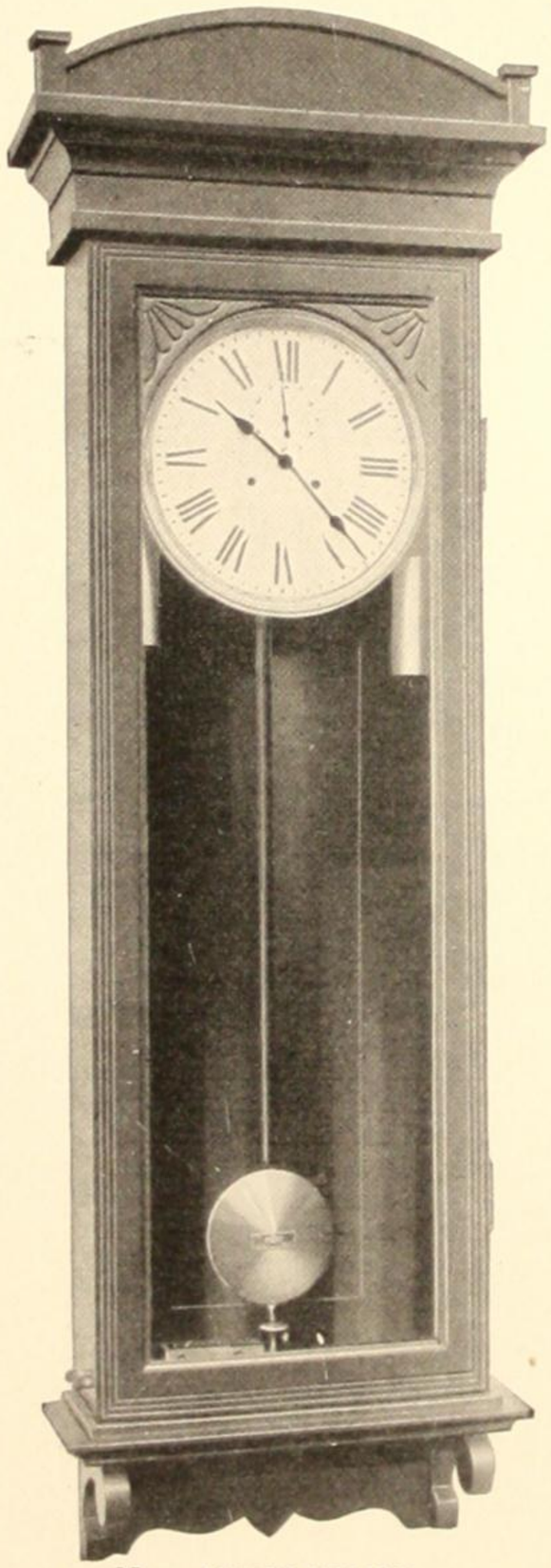
268M. Cathetometer. Range, 100 cm. For the precise measurement of differences in level-vertical distances. The vertical pillar is a 30 mm. x 120 cm. white-nickeled steel rod mounted on a heavy tripod with leveling screws. The column is graduated to millimeters and the telescope slide is provided with a vernier so that readings direct to 0.1 mm. can be taken. The well-fitted long sliding sleeve provides smooth vertical motion exactly parallel to the pillar. Height adjustments are made by sliding the collar on which the telescope sleeve rotates. The telescope support is equipped with sensitive level and delicate tilting adjustment. The 25 mm. aperture, 18 power telescope is equipped with cross-hairs, rack and pinion, and draw tube. Readings can be taken at distances of 55 cm. to 10 meters.....**$100.00**



No. 4230M.



No. 269M.



Nos. 4240M-4245M.

269M. Chart, International Metric System. Valuable for teaching the metric system. Contains full-sized illustrations of metric standards of length (Meter), area (Square Decimeter), volume (Cubic Decimeter), capacity (Liter), weight (Half-Kilo), etc., with corresponding units in the English System. Also comparison tables of Lengths, Areas, Volumes, Capacities, and Weights in the Metric and English systems, as well as tables of derivation of the names of metric units. Size 25x41 inches, mounted on cloth back, with common rollers.....**$2.00**

4230M. Clock, Interval. For timing any laboratory process or operation of 1 to 90 minutes' duration; can be instantly set with a turn of the knob in the lower right corner to any exact number of minutes—1 to 90. Right on the dot; when the desired number of minutes are up it rings a bell persistently until answered and stopped by shifting the knob in the lower left corner to the "Off" position. Also a reliable timekeeper **$7.50**

4240M. Clock, Laboratory (Gaertner). An 8-day, weight-driven clock with a good reliable movement.

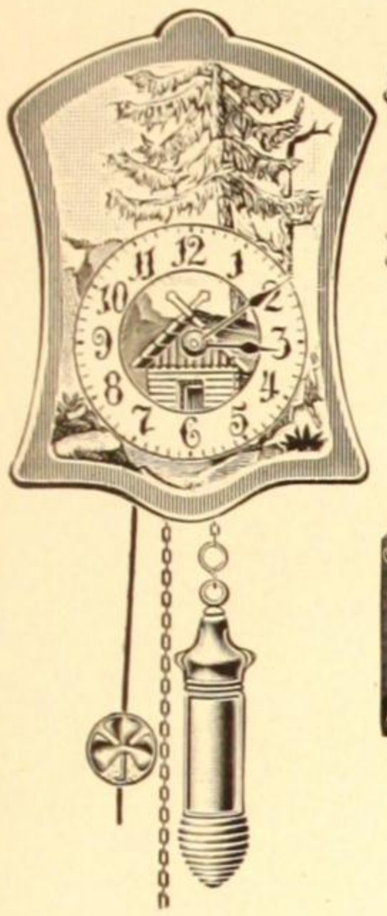
The gears are carefully cut and machined from hard rolled clock brass. The pinions and arbors are of steel, tempered and highly polished. The dial is 12 inches in diameter with large Roman numerals.

The pendulum beats full seconds; the bar is made of well seasoned wood with a heavy bob, 6 inches in diameter.

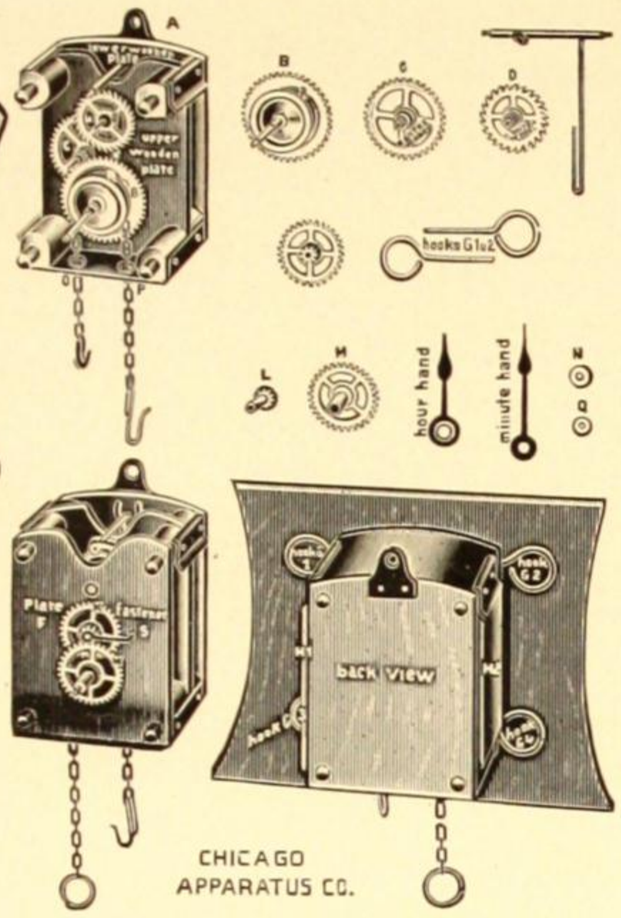
A platinum point at the end of the bar sweeps over a mercury contact, attached to the bottom of the clock case. The mercury contact is provided with all the necessary adjustments. It is also equipped with a small cup in which the spilled mercury collects. The electrical connections are brought to the binding posts on the outside of case.

The movement is mounted in a beautiful mahogany case, 60 inches high and 20 inches wide with glass paneled door.....**$87.50**

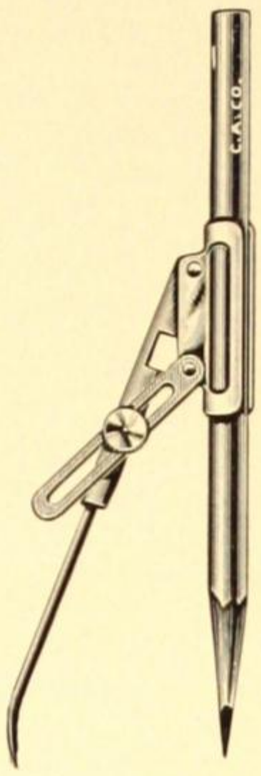
4245M. Clock, Laboratory (Gaertner). The same as No. 4240M, except with Magnetic Contact **$117.50**



(Assembled.)



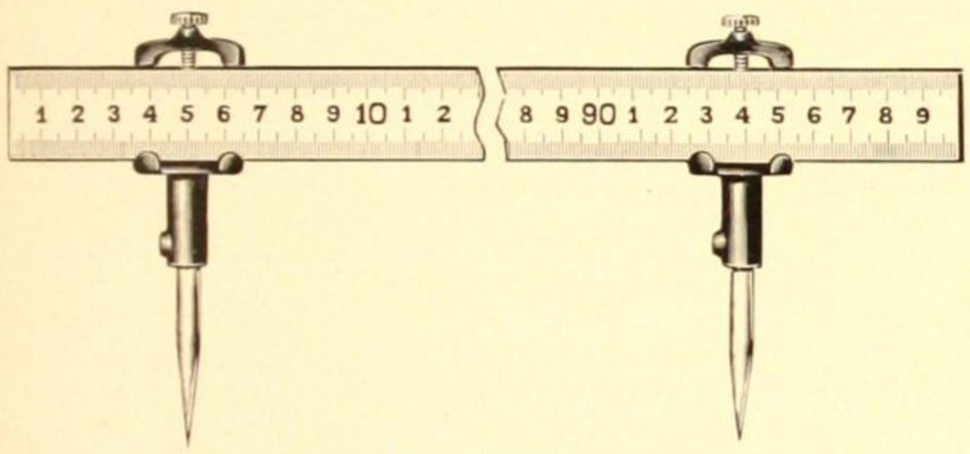
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No. 271M.



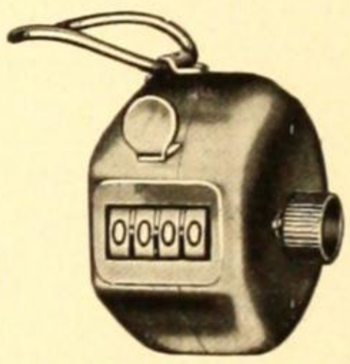
No. 272M.



No. 4260M.



No. 273M.



No. 275M.

270M. **Clock, Dissected.** For studying the mechanics of a weight-driven clock. Requires no mechanical skill to assemble. A most ingenious and remarkable assortment of clock parts, which a student can put together in a few minutes without the use of tools. The assembled clock is neat in appearance and capable of giving many years of good time-keeping service. The works are mounted on a card and are suitably designated by numbers and letters. The pendulum and wooden case are separate. The whole is packed in a neat box accompanied by full and simple directions. The parts are so exactly and perfectly made that each fits precisely into its proper place. No screws are required, no special tools are necessary. The parts are strongly and substantially made and suffer no injury from ordinary handling...**$4.50**

271M. **Compass, Pencil.** Easily attached to common pencil. Without pencil.....**Each $0.15**

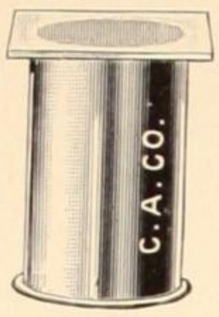
272M. **Compass, Pencil.** Pen, pencil, divider and compass combined. Provided with set nut. Length 5½ inches over all. Complete with extra leads. **Each $0.40**

4260M. **Compass Points, Beam.** A pair of these points and a meter stick (either ½, 1 or 2 meters long) makes an ideal beam compass that has many laboratory uses, such as: Measuring distances on rounded, irregular or obstructed surfaces; measuring pendulum length; measuring the length of wires used in modulus experiments; and for measuring parts of apparatus not accessible with straight edge rules. In more precise work the distance between the points, when set, can be more accurately measured by placing them down on a high grade steel rule. The steel points are very sharp and mounted in die-cast clamps which fit the standard meter stick. Distance between tip of point and nearest edge of meter stick is three inches.

Per pair, without meter stick.....**$2.50**

273M. **Cone, Sphere and Cylinder.** For showing the relation between the contents of a cone, sphere and cylinder, the dimensions of which are equal. Actual demonstration shows that the cone three times filled with water fills the cylinder, and that if the cylinder is filled with water and then the sphere entirely immersed, there will remain in the cylinder just water enough to fill the cone, thus showing that their contents are as 1:2:3. Packed in neat box.....**$2.75**

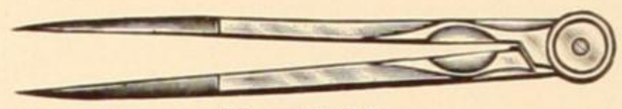
275M. **Counter, Hand Tally.** Has four figured wheels operated by pressure of the thumb lever. Registers up to 9,999. Sets back to zero from any figure by one turn of knob at right. Case has rounded corners so as not to irritate the hand of the user, nor wear the pocket when carried. Finger ring is so located that counter may be held in either hand when in use. Useful in counting pendulum swings, rotator revolutions, etc. Nickel-plated.....**$5.00**



No. 278M.



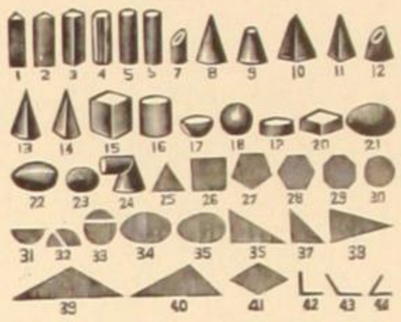
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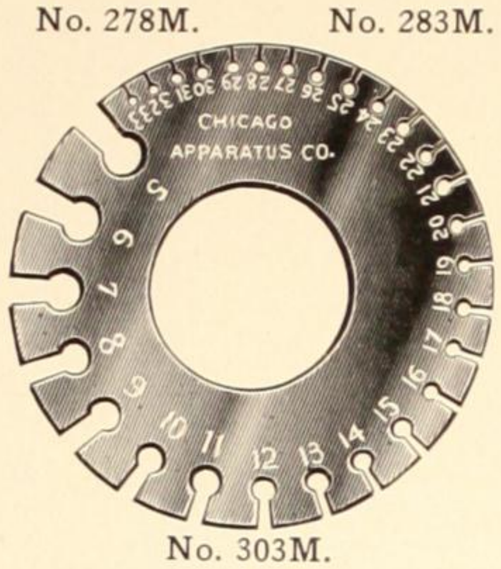
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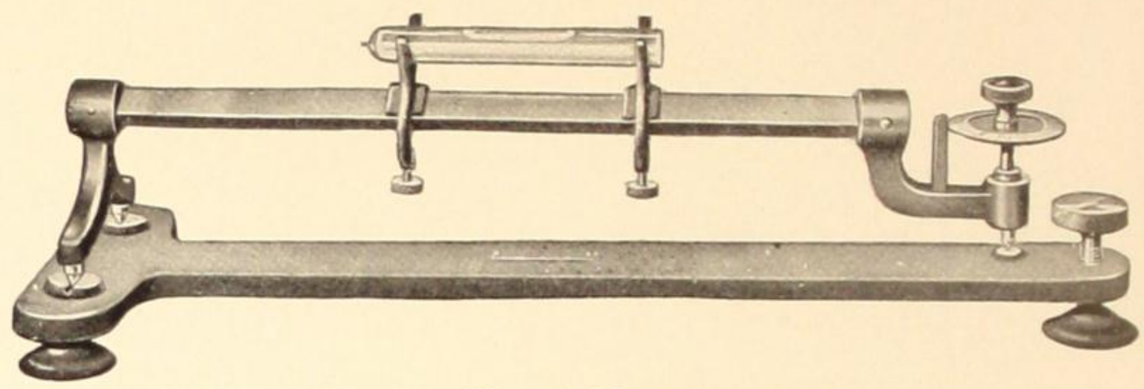
No. 298M.



No. 308M.



No. 303M.



No. 310M.

278M. Cylindrical Vessel. As used in Millikan, Gale and Bishop's Course. Brass, accurate internal dimensions, height 8 cm., diameter 5 cm., capacity about 125 cc., with 63x63 mm. ground glass cover $0.50

279M. Extra Glass Covers for No. 278M. **Each $0.10**

283M. Disk, Measuring. As used in Millikan, Gale and Bishop's Course. Metal, accurately turned, diameter 8 cm., with radius mark..... $0.15

284M. Disk, Measuring. Brass, 12.5 cm. diameter, accurately turned and finely finished..... $0.75

288M. Divider, Plain. Brass, with sharp steel points. Length, 11.5 cm. $0.60

298M. Gage, Tube. Range 0 to 15 millimeters, by 1/10 millimeters. For measuring the diameter of holes, the bore of glass and rubber tubing, etc. Made of metal, finely polished..... $1.50

303M. Gage, Wire. American Standard (B. & S.). Takes in numbers 5 to 36. The decimal equivalents of each number are stamped on the back. Each gage is tested after hardening and is warranted accurate $2.50

304M. Gage, Wire. Takes in numbers 0 to 36, otherwise same as No. 303M..... $3.00

308M. Geometrical Solids and Surfaces. This set of forms embraces the common surfaces and solids which are found in elementary geometry, together with a simple illustration of angles. There are twenty-three solids, seventeen surfaces and three angles, the latter being represented by bent wires. The solids are accurately and neatly made from well-seasoned hardwood and the surfaces from a very hard light-colored board, accurately cut with steel dies. The curves of the Conic Sections, Ellipse, Parabola and Hyperbola are very clearly indicated by the plane surface on three separate cones. Put up in a strong wooden box $3.75

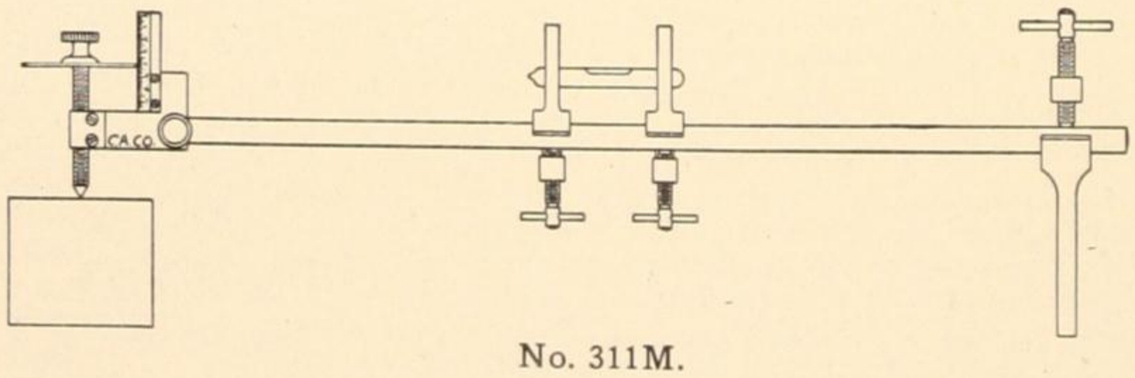
310M. Level Tester—Precision Type. For calibrating and testing levels, also suitable for laboratory experiments in connection with levels. Makes a high-grade optical lever when used in connection with a small lever. The micrometer head is divided into 100 parts, pitch of screws 0.5 mm. Vertical scale is graduated for 30 mm. in mm. Iron base is provided with leveling screws $50.00

311M. Level Tester, Simple Form. Suitable for elementary laboratory work and lecture demonstrations. Consists of an assembly of the following standard parts: 1 No. 206T V Support, 2 No. 205T V Supports, 1 No. 143T 60 cm. Rod, 1 No. 380M Micrometer Screw, and a No. 312Ma Level Glass.... $17.00

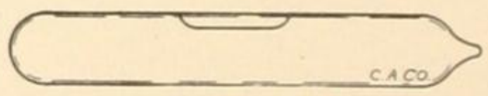
312M. Level Glasses. For students' use in level testing experiments. Level testing falls into two classes: 1. Calibration of a plain level according to a preselected sensitiveness. No. A is suited for this purpose. 2. Determination of sensitiveness of a graduated level. Nos. B and C are excellent for this type of work. The sensitiveness of Nos. B and C lies between 30 to 60 seconds of arc, but the actual sensitiveness can only be learned by test. They are graduated in 2.5 mm. divisions.

No.	A	B	C
Type	Plain	Graduated	Graduated
Length, cm.	7.5	5 to 6	7 to 9
Each	**$0.25**	**1.00**	**1.25**

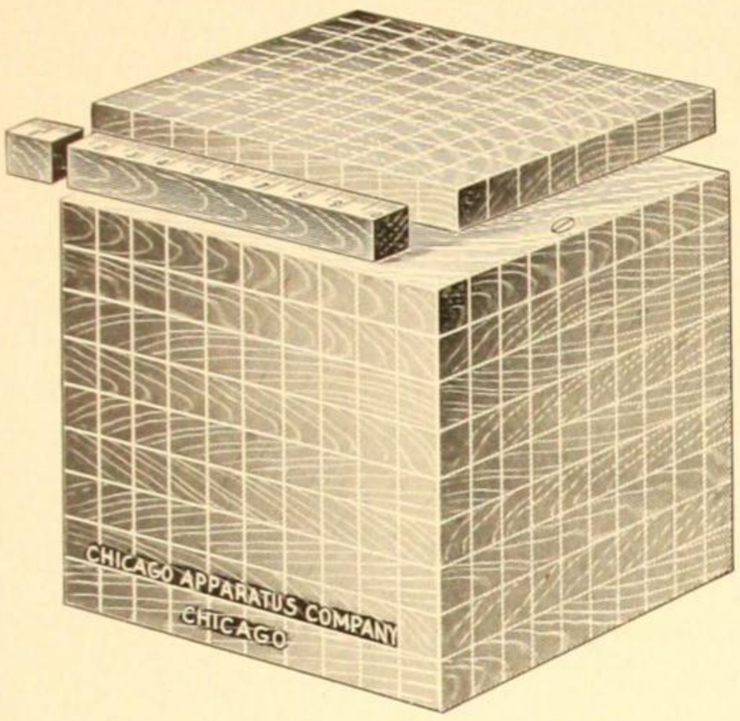
10% Discount in lots of 12.



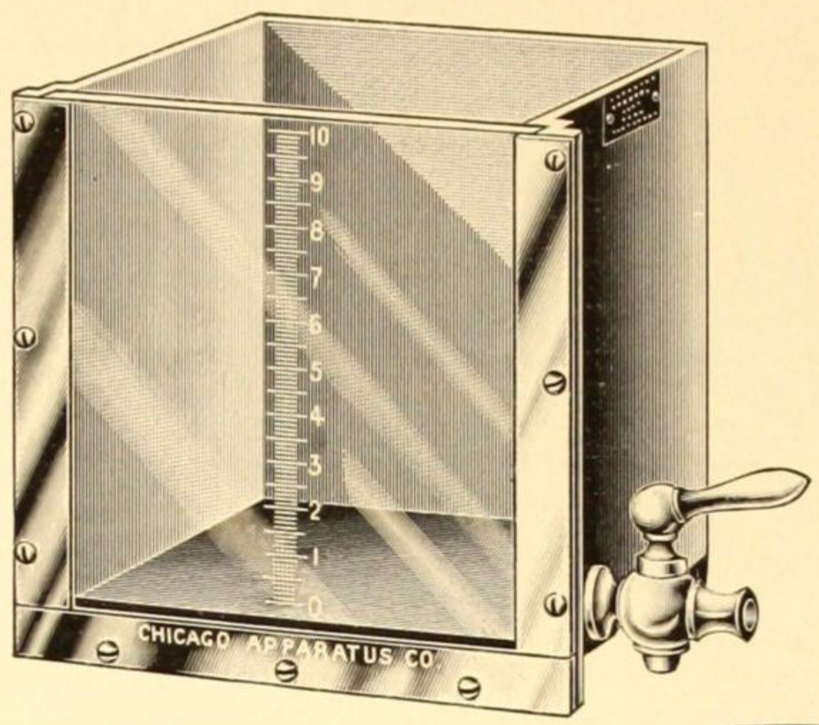
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No. 312M.



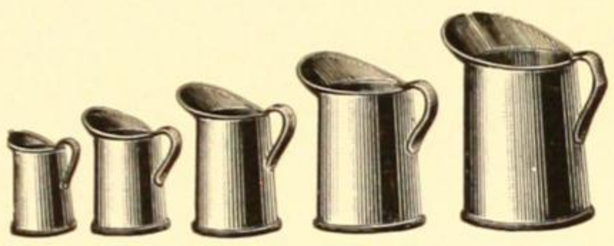
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No. 317M.



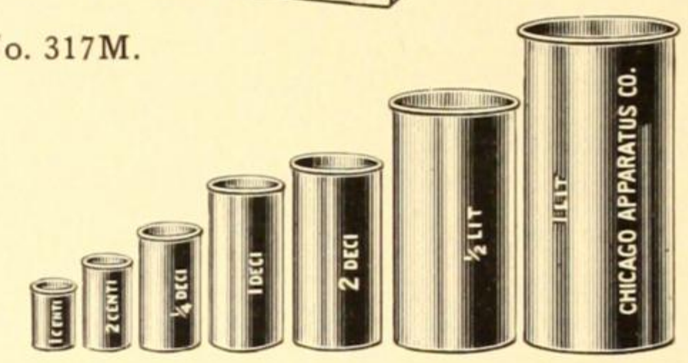
No. 323M.



No. 338M.



No. 328M.



No. 340M.

313M. Liter Block. Loaded and dissectible. Excellent for teaching the principles of the metric system. Consists of a decimeter wood cube (10x10x10 cm.) with all surfaces graduated into square centimeters. It is separable into 1/10, 1/100 and 1/1000 of its volume, each part being loaded to the specific gravity of water **$4.50**

317M. Liter Case, Milvay. The copper case employed for many years in the construction of this device has now been replaced with one of cast aluminum. The latter is inflexible. It cannot be dented and will not bulge, buckle or spring out of shape like cases made of copper or other metals. Therefore, it provides a measure of unvarying volumetric capacity. Also it has resulted in an improvement in appearance.

The internal dimensions are those of a hollow decimeter cube—10x10x10 cm.—forming a counterpart of our No. 313M Dissectible Liter Block. The glass front provides for inspection of water level and contents. The etched millimeter scale makes for greater accuracy in reading height of the water level and the stopcock for a nicer adjustment than is possible in common capacity measures.

In use, the liter case is placed on a scale, and its weight with water to the zero mark, is counterpoised. Water is then added to the 10 cm. mark. Since the length and width of the case are also 10 cm., it is evident that the volume of water added is exactly 1000 cm., or one liter. Counterpoising this added volume will show its weight to be exactly 1000 grams. Similarly, the weight of other volumes of water—10 cu. cm., 100 cu. cm., etc., can be weighed. By using other liquids or solutions, their volume weight can be determined in the same manner, and from the data so obtained, their specific gravities calculated.

To determine the density of an irregular non-floating object, first obtain its weight on a balance. Then with water in the case up to a suitable height, completely immerse the object. The difference between the levels before and after immersion indicates its displacement, or volume. From its known weight and volume its density can now be readily calculated.

In materials, workmanship, accuracy and appearance, this new liter case is unexcelled..... **$6.75**

323M. Measures, Dry. Made from finest quality galvanized iron, heavily wired around top and with double seamed bottom, capacity stenciled on each measure. Set of five pieces—1, 2 and 4 quarts, 1 peck and ½ bushel. ..... **Per set $4.00**

328M. Measure, Liquid. Bright tin, capacity one quart, marked in ½ pints..... **$0.30**

338M. Measures, Liquid. Bright tin, with spout and handle. Set of five pieces—½ pint, 1 pint, 1 quart, ½ gallon, 1 gallon ..... **Per set $2.00**

340M. Measures, Liter, Set of Seven. Metric measures of polished brass, standard form (diameter equals half the height). Set includes the following sizes: .01, .02, .05, .1, .2, .5, and 1 liter... **Per set $5.00**

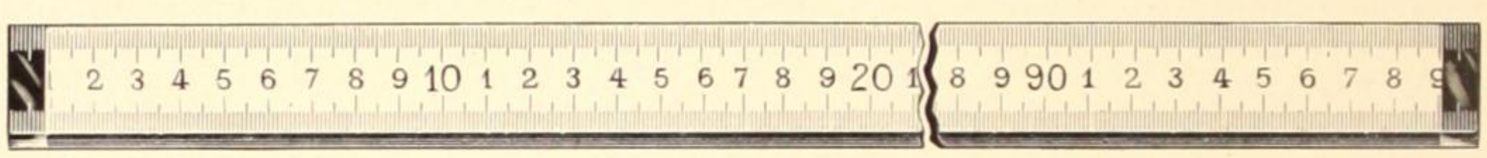
341M. Measure, Liter. Single liter measure only of set No. 340M **$1.25**



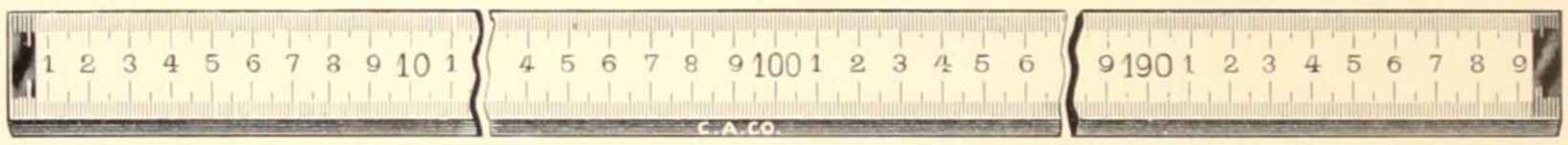
No. 353M.



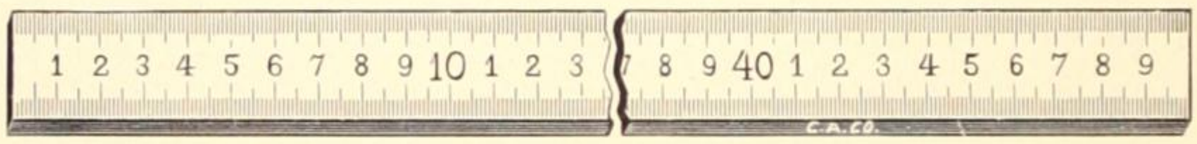
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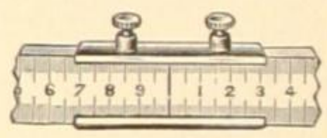
No. 363M.



No. 364M.



No. 365M.



No. 368M.

353M. Meter Stick. Maple, 2 cm. square. For teaching the metric system of lengths. One face is plain and shows the length of the simple meter; the second face is graduated in decimeters (tenths of meters); the third face in centimeters (hundredths of meters); the fourth face in millimeters (thousandths of meters). The fourth face gives divisions also in decimeters and centimeters **$1.50**

358M. Meter Stick, Maple, One Meter Long. Standard size—25 mm. wide by 8 mm. thick. One side graduated to 100 cm. in millimeters, centimeters, and decimeters along both edges; the other side in inches and eighths **$0.35**

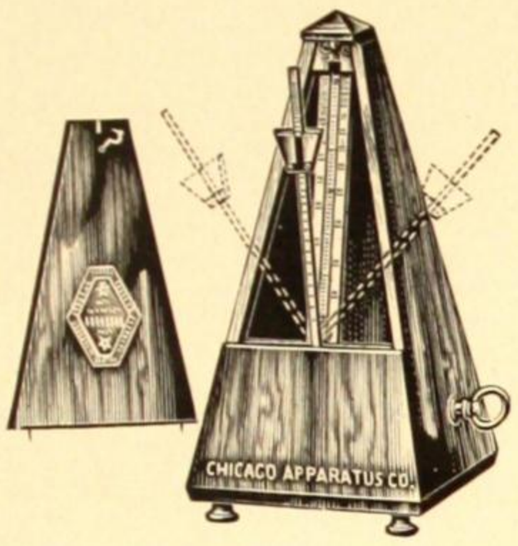
359M. Meter Stick, Boxwood, One Meter Long. Size 26 mm. wide by 4 mm. thick. Graduated on one side in millimeters and eighths of an inch..... **$1.00**

363M. Meter Stick, Maple, One Meter Long. Same as No. 358M, but with brass tipped ends..... **$0.65**

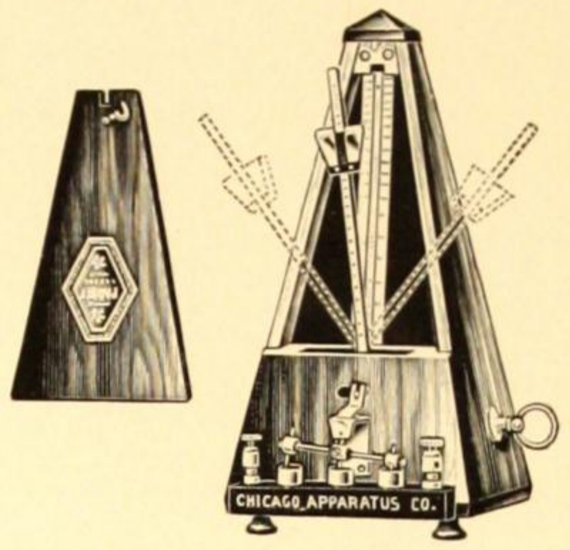
364M. Meter Stick, Maple, Two Meters Long. Standard size, 25 mm. wide by 8 mm. thick. A one-piece stick (not two pieces joined together) graduated on one side along both edges to 200 cm. in millimeters and on the other side to 78⅝ inches in eighths. With brass-tipped ends **$2.00**

365M. Meter Stick, Maple, Half Meter Long. Standard size, 25 mm. wide by 8 mm. thick. One side graduated to 50 cm. in millimeters, the other to eighths of an inch..... **$0.30**

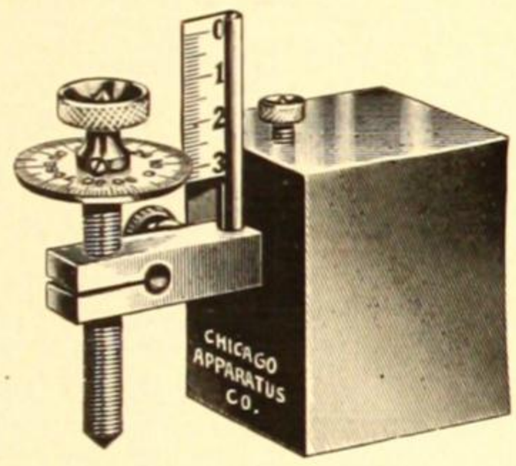
368M. Meter Stick Coupling. For joining two No. 358M Meter Sticks together to make one stick two meters long—double meter stick..... **$1.00**



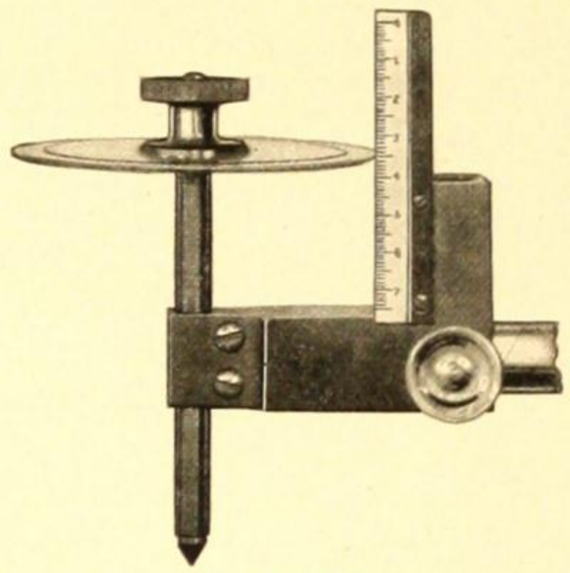
No. 373M.



No. 376M.



No. 378M.



No. 380M.

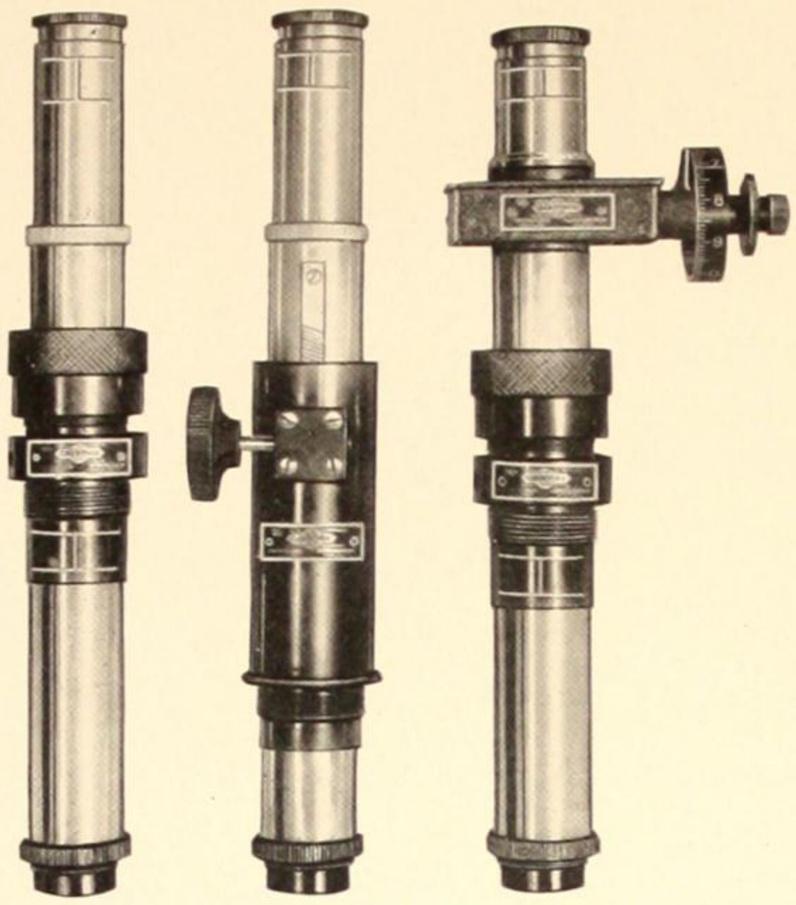
373M Metronome. For counting seconds and fractional parts of a second, etc. Each swing of the pendulum produces an audible click. Bob on pendulum can be set to produce any number of clicks per minute from 40 up to 208. When set at 60, beats seconds; at 120, half seconds. In polished mahogany case. Height, 24 cm. **$6.75**

375M. Metronome, With Bell. Same as No. 373M, but with adjustable bell attachment. Can be set to strike every second, third, fourth, or sixth beat. **$8.50**

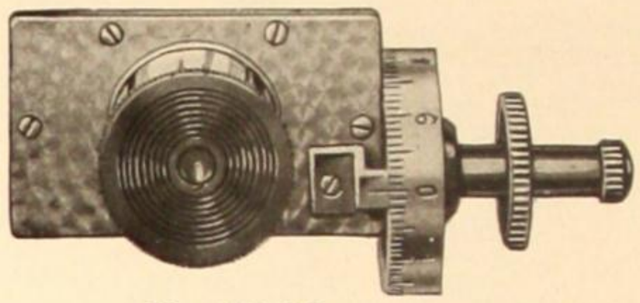
376M. Metronome, Mercury Contact Type. Provided with three steel mercury wells and two binding posts for connection into an electrical circuit with a time marker for producing time-interval traces on recording drums or kymographs. May also be used for the nearby or remote control of telegraph sounders for audibly clicking off time intervals. Contact is made at the end of each pendulum swing. Bob on pendulum can be set to make 40 to 208 contacts per minute. Clicks seconds when set at 60, half-seconds at 120, etc. The steel needles at the ends of the rocker arm can be readily adjusted to secure contacts of shortest duration. We recommend the mercury contact type metronome in preference to the metal blade contact type because it is more positive and because of the absence of friction, more accurate **$17.50**

378M. Micrometer Screw, Milvay. For measuring beam flexures and other displacements up to 30 millimeters accurately to 1/100th mm. Mounted on heavy accurately machined steel block 50x50x62 mm. The bracket on which the screw and scale are placed is removable. This permits its use in either vertical or horizontal position or removable for use on other apparatus. Binding post on bracket is provided for electrical connection. Pitch of screw, 1 mm.; length, 65 mm.; range, 30 mm.; head, 4 cm. in diameter, divided into 100 parts **$6.75**

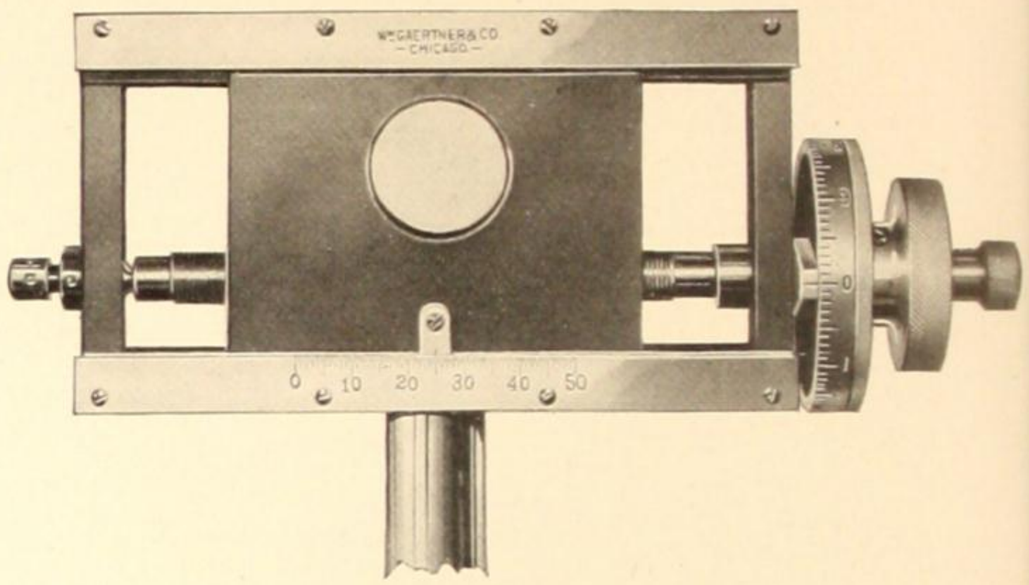
380M. Micrometer Screw. For use in set-ups of apparatus intended for measuring expansion, bending and stretching of rods, testing of levels, etc. The mount has a 13 mm. hole parallel and another at right angles to the screw, permitting it to be supported in any desired position. The accurately cut and well corrected screw has a range of 25 mm. with graduated scale to correspond. Screw diameter—5 mm.; pitch—0.5 mm.; head diameter—45 mm.; number of head divisions—100. Reads direct to .005 mm. and by estimation this can be carried to .001 mm. **$12.50**



No. 4265M. No. 4270M. No. 4275M.



No. 4280M.



No. 4290M.

4265M. Microscope, Measuring (Gaertner). For physical and mechanical measurements. Tube length is fixed to prevent change in value of micrometer readings. Sleeve is threaded to fit arm of No. 4295M Support. The achromatic objective is of fine optical quality. Eyepiece gives large flat field free of color. Cross hairs are placed at an angle of 60° to allow accurate bisecting of a single line. Tube is of special hard nickel silver. Magnifying power—32 diameters; tube length—160 mm.; outside tube diameter—22.2 mm.; aperture of objective—10 mm.; working distance—50 mm.; field of view—sufficient to include image of a space 3.3 mm. in diameter. Provided with threaded sleeve fitting either No. 4290M Slide or No. 4295M Support.....**$18.00**

4270M. Microscope, Measuring (Gaertner). Same as No. 4265M, but fitted with rack and pinion for convenience in focusing **$26.00**

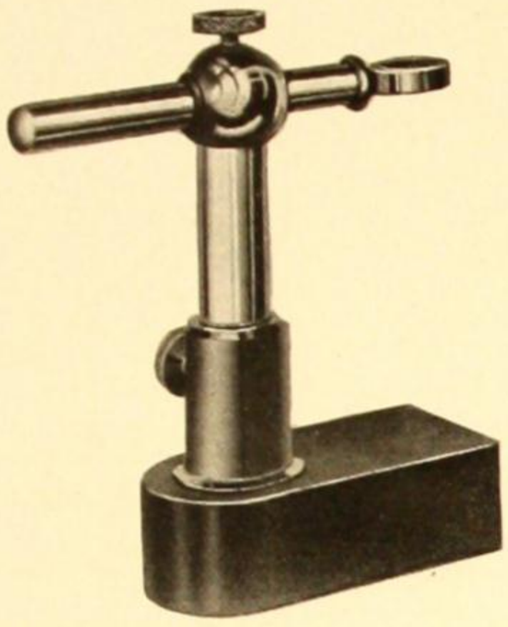
4275M. Microscope, Measuring (Gaertner). Similar to No. 4265 M, but with Ramsden filar micrometer eyepiece. The two fixed wires are at right angles and pass through the center of the field of vision. The two movable wires are 0.05 mm. apart. A "comb" in the eyepiece field registers the whole revolutions of the micrometer screw. Measurements of a very high order of accuracy are possible with this instrument. The micrometer screw pitch is 0.25 mm., while the drum head is divided into 100 equal parts, making it possible to read the image at the cross hairs directly to 0.0025 mm. Since the image has been magnified to 3.2 diameters by the objective, the equivalent reading on the object being measured is 0.00078 mm. The range of the micrometer screw is about 10 mm. Eyepiece power—10 diameters; objective power—3.2 diameters; total magnification—32 diameters; fixed tube length—160 mm.; working distance—50 mm.; field of view—sufficient to include image of a space 3.1 mm. in diameter. Provided with threaded sleeve fitting either No. 4290M Slide or No. 4295M Support **$54.50**

4280M. Filar Micrometer, Range 10 mm. (Gaertner). An instrument of the highest order of workmanship, permitting quick and accurate measurements over a short range. The screw is ¼ mm. pitch, fitted with a nut which moves along a carriage upon which are permanently attached two cross wires .05 mm. apart. Two other cross wires fixed, intersect at right angles in the center of the field. A comb mounted in the field indicates full revolutions of the screw....**$40.00**

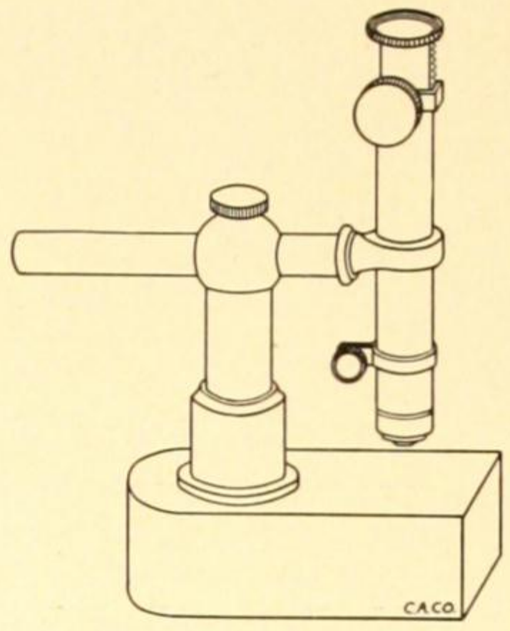
4290M. Micrometer Slide (Gaertner). For use in connection with a microscope and support for measurements of larger ranges—ranges up to 50 mm. A most useful laboratory device in short range cathetometer work, determination of stretch of wire in Hooke's Law experiments, liquid rise in capillary tubes, extent of small movements, etc.

The pitch of the micrometer screw is 1 mm., while the turning drum is divided into 100 equal parts, making possible readings direct to 1-100 mm., which by estimation can be carried to 1-1000 mm. The range of the screw is 50 mm. and its diameter 10 mm. The bedplate and carriage are of hard brass, the guides accurately scraped straight, and the carriage carefully fitted.

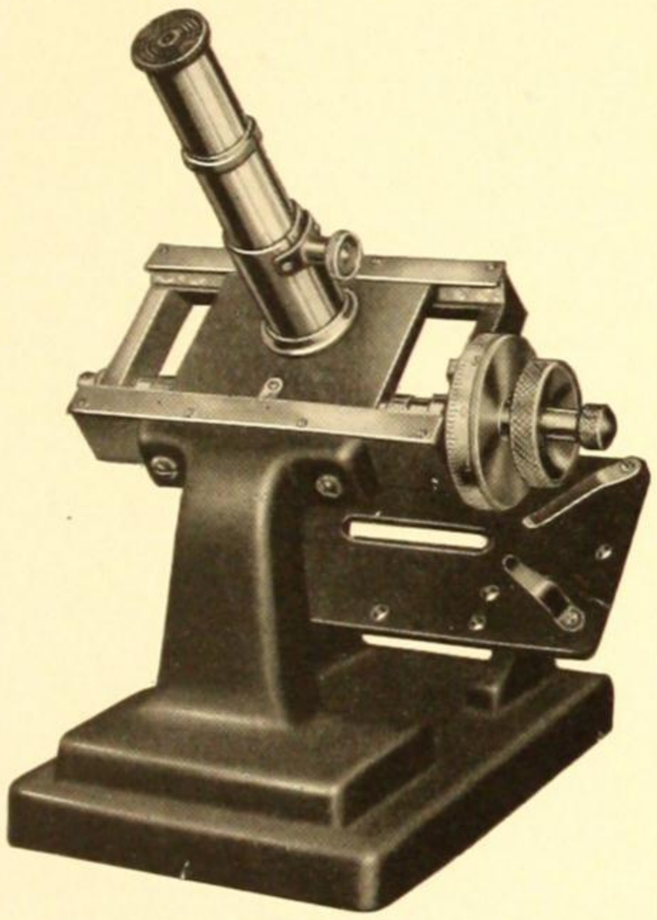
Users report that after nearly twenty years of service in thousands of measurements they are still getting remarkably accurate results—a fine tribute to the high-class character of the material and workmanship in these slides. Provided with a 19 mm. x 15 cm. round supporting shank fitting No. 4295M and other supports **$65.00**



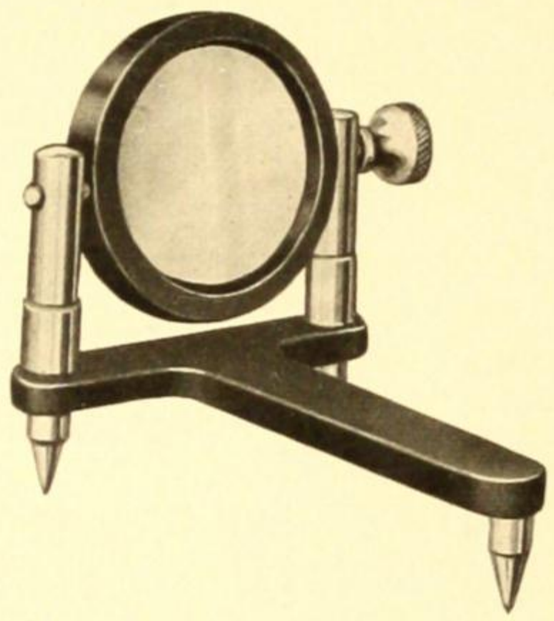
No. 4295M.



No. 4295M with No. 4270M in place.



No. 4300M.



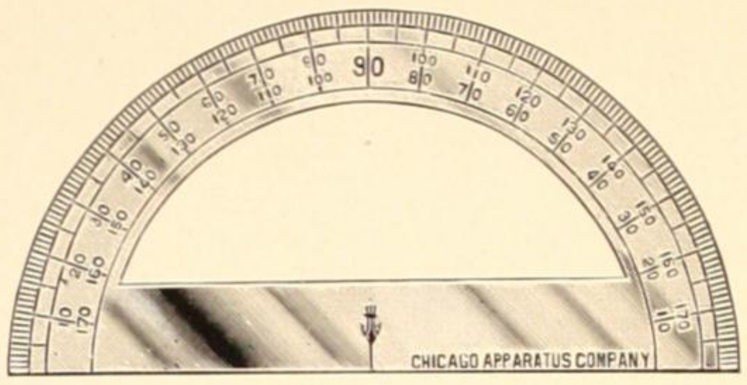
No. 382M.

4295M. Microscope Support (Gaertner). For rigidly supporting Microscopes No. 4265M or 4275M in any position at the end of a horizontal arm. The base weight is ample to insure the steadiness required in microscope measurement work. The top surface is planed true. Both rods fit snugly into their sockets and can be firmly locked in any position. The horizontal arm when replaced with Micrometer Slide No. 4290M, with a microscope in place on the latter, provides a complete unit for wide range measurement work. Support only, as illustrated...**$15.00**

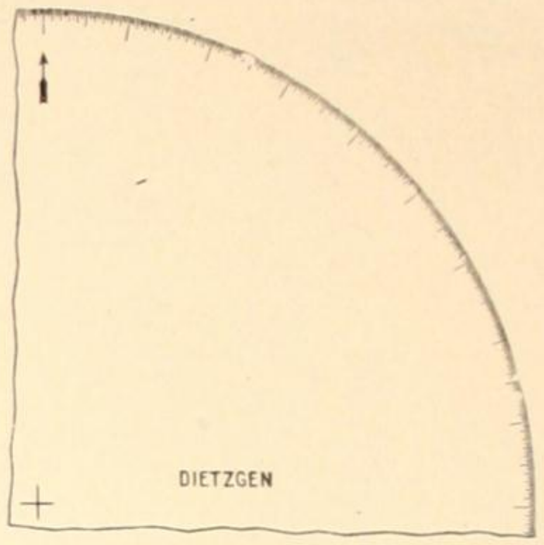
4300M. Microscope, Micrometer (Gaertner). This comparator is intended for measuring—rapidly and with a high order of accuracy—spectra photographs, gratings, scales, and other objects than can be held on the stage and focused by the microscope. The microscope is the same as No. 4265M and the micrometer slide like No. 4290M. Both are mounted at an angle most convenient for the observer, a feature which will be appreciated in protracted work. The stage is normal to the axis of the microscope and provided with slit and four clips. Illumination for transparent objects is given from below by means of a plane mirror. Travel range of microscope—50 mm.; pitch of screw—1 mm.; divisions on turning drum—100. Readings direct to .01 mm. are possible and, by estimation, this can be carried to .001 mm. For microscope specifications see No. 4265M. Complete as illustrated and described.....**$110.00**

382M. Optical Lever (Gaertner). Very desirable for measuring in connection with a reading telescope and scale, small vertical deflections due to bending, expansion, contraction, elongation, etc. In this new improved design the mirror is made of **stainless steel** polished optically flat. The decided advantage of stainless steel is the unbreakable property, permanency of the reflecting surface and flatness. The mirror is 35 mm. in diameter, mounted in a suitable frame fitted with three legs of hardened steel giving an effective leverage of 75 mm.....**$7.00**

Protractors, Rules and Scales



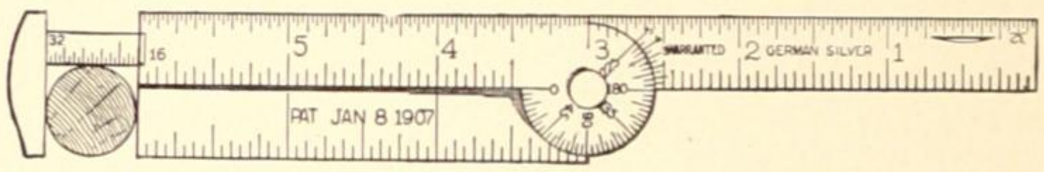
Nos. 383M—388M—393M—398M.



No. 390M.



No. 1450B.



No. 403M.



No. 408M.

383M. Protractors, Brass. Half circle.

Cat. No.	383M	384M	385M
Diameter, inches	3¾	4¼	5⅛
Smallest division, degrees	1	1	½
Each	**$0.15**	.20	.60

388M. Protractors, Cardboard. Half circle, 4-inch diameter, 1 degree divisions.

Each **$0.06**
Per dozen ..... .60

390M. Protractors, Cardboard. Whole circle, on bristol board, graduations not numbered.

Cat. No.	390M	391M
Diameter, inches	8	14
Smallest division, degrees	½	¼
Each	**$0.25**	.50

393M. Protractor, Celluloid. Transparent, half circle; 5 inches in diameter; 1 degree divisions..... **$0.50**

398M. Protractor, German Silver. Half circle.

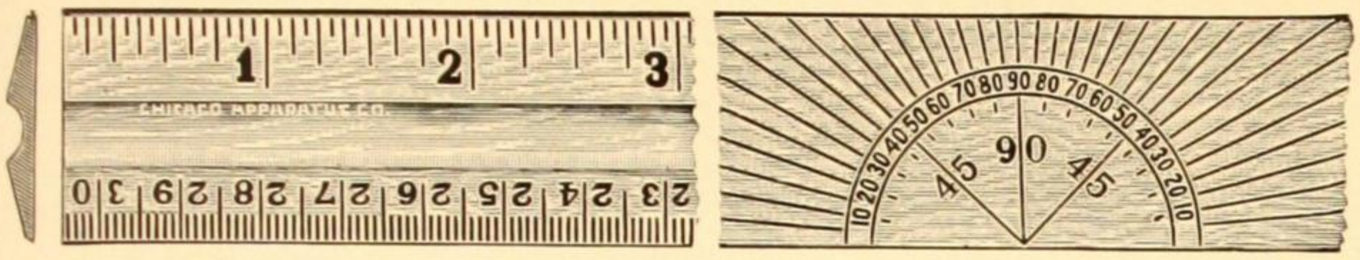
Cat. No.	398M	399M
Diameter, inches	4¼	5⅛
Smallest division, degrees	1	½
Each	**$0.50**	.75

1450B. Rule, Celluloid. Metric and English, 6 inches long. One edge graduated in mm., the other in eighth inches. An ideal rule for comparisons in the Metric and English systems, as both scales are numbered from the same end. Fits dissecting sets and vest pockets.

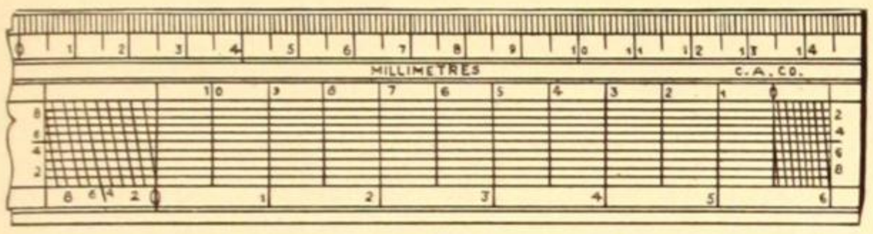
Each **$0.10**
Per hundred 8.00

403M. Rule, Combination. Johnson's. Folding, 6 inches, nickeled silver, combines caliper rule, try square, bevel square, and protractor. Marked in 8ths, 16ths and 32nds inches. Adjustable to any angle. Vernier reads to ½ degree. Center joint is constructed so rule remains firm in any position **$3.25**

408M. Rule, Steel. Metric decimeter rule. One decimeter long, one centimeter wide, one millimeter thick, graduated in millimeters. Its weight in grams is the specific gravity of steel. In leather case..... **$0.60**



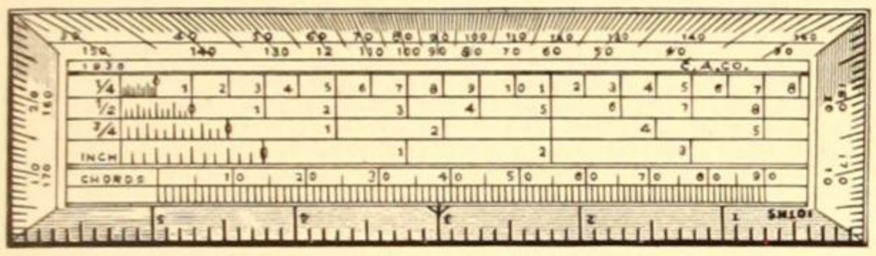
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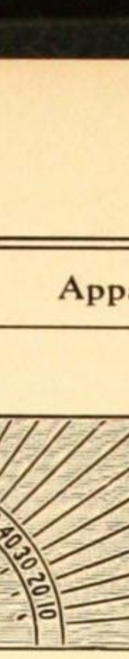
No. 447M.



No. 420M.



No. 448M.



No. 450M.



No. 449M.

420M. Scale, Steel, Metric and English, 4 inches long. Graduated as follows:
First Edge: In millimeters.
Second Edge: In half-millimeters.
Third Edge: 1 inch in 16ths, 2 inches in 32nds, 1 inch in 64ths.
Fourth Edge: 1 inch in 10ths, 1 inch in 20ths, 1 inch in 50ths, 1 inch in 100ths.
Each **$0.75**

422M. Scale, Steel, Metric and English, 20 cm. long. Graduated as follows:
First Edge: In millimeters.
Second Edge: In half-millimeters.
Third Edge: 5¾ inches in 16ths, 2 inches in 64ths.
Fourth Edge: 5.8 inches in 50ths, 2 inches in 100ths.
Each **$1.40**

424M. Scale, Steel, Metric and English, 12 inches long. Graduated as follows:
First Edge: In millimeters.
Second Edge: In half-millimeters.
Third Edge: 9 inches in 16ths, 2 inches in 32nds, 1 inch in 64ths.
Fourth Edge: 9 inches in 1/10ths, 1 inch in 20ths, 1 inch in 50ths, 1 inch in 100ths.
Each **$1.65**

426M. Scale, Steel, Metric and English, 100 cm. long. Graduated as follows:
First Edge: In millimeters.
Second Edge: In half-millimeters.
Third Edge: In inches and 32nds.
Fourth Edge: In inches and 64ths.
In the physical laboratory this dependable scale, which is not affected by age, serves a two-fold purpose: (1) It provides an accurate measure for use in very precise work. (2) It provides a standard against which the accuracies of ordinary wooden meter sticks, which vary with age, may be checked **$10.00**

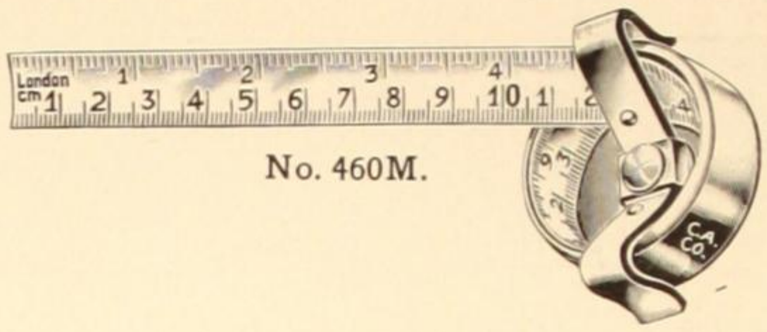
433M. Ruler, Maple. Metric and English, 12 inches long, one edge graduated in inches and 16ths, the other edge in centimeters and millimeters. Double beveled with protractor (5 degree divisions) on back.
Each **$0.06**
Per dozen ..... **.60**

447M. Scale, Diagonal or Plotting, English and Metric. Ten scales and protractor combined: Six-inch scales in 1/8ths and 1/10ths; 14 cm. scale in mm.; scale of chords; scales of ¼, ½, ¾ and 1 inch to the foot; diagonal scales of 10ths, 20ths, 80ths, and 160ths of an inch; and protractor reading in either direction to 180° and 1° divisions. Of boxwood; overall size, 6x1⅝ inches **$0.45**

448M. Scale, Diagonal and Plotting Metric. Of boxwood, with ten scales as follows: 15 cm. divided into mm.; scale of chords, diagonal scales of 1/10 and 1/5 mm.; and plotting scales of .5, .66, .8, 1, 1.67 and 2 cm. to the meter **$0.45**

449M. Scale, Mirror. As used on No. 85B Jolly's Balance. Of polished nickel-silver, graduated for 70 cm. in millimeters. Overall dimensions, 72x2.5 cm. For use vertically; zero at the top..... **$1.50**

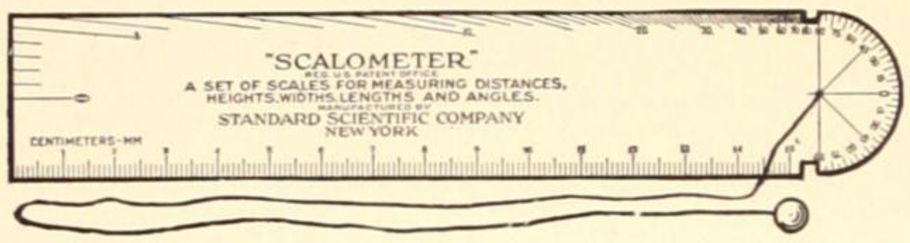
450M. Scale, Mirror. As used on No. 395S Hooke's Law Mirror. Of polished nickel-silver, graduated for 15 cm. in millimeters. Overall dimensions, 16.5 x 2.5 cm. For use vertically, zero at the top..... **$0.60**



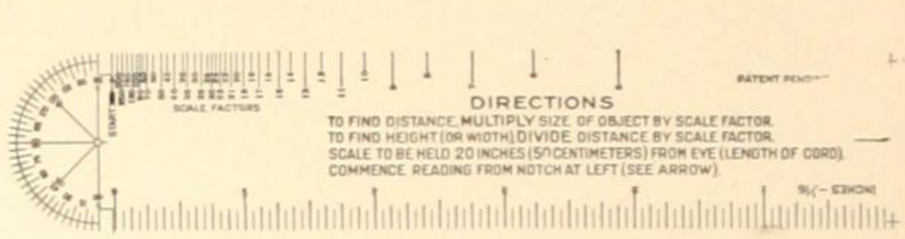
No. 460M.



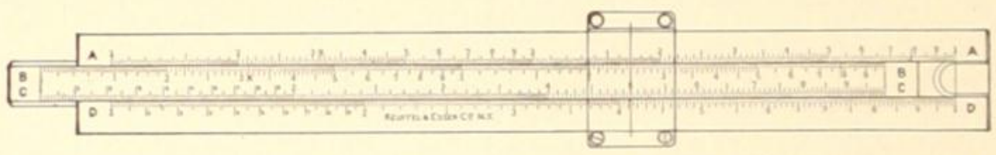
No. 455M.



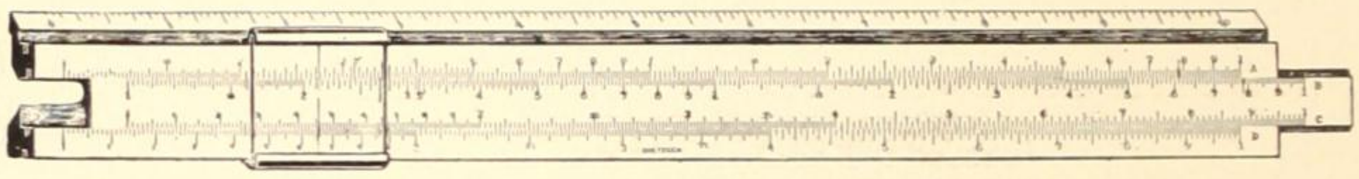
No. 462M (Front).



No. 462M (Back).



No. 463M.



No. 468M.

453M. Scale, Paper. Metric; on heavy white bond paper, 23.5x3.5 cm.; graduated along one edge for 20 cm. in millimeters.
Per dozen **$0.10**
Per hundred ..... **.75**

458M. Scale, Paper. Metric, one meter long, 22 mm. wide, graduated in millimeters, zero at left hand end.
Each **$0.06**
Per dozen ..... **.65**

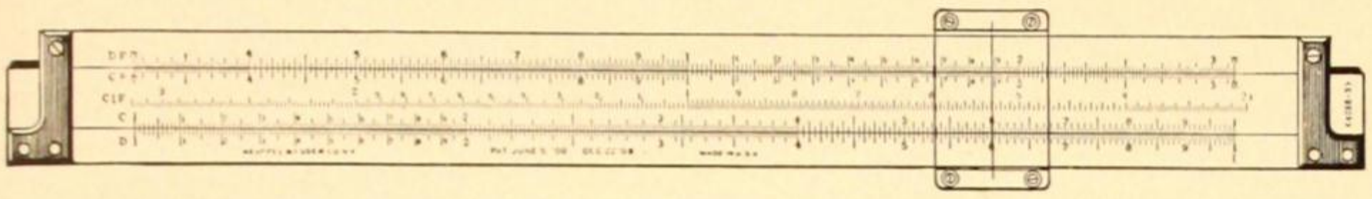
455M. Scale Paper. For reading telescope. Graduated 25-0-25 cm. in millimeters. Figures in reverse to read correctly when reflected. Overall length, 50 cm.
Each **$0.10**
Per dozen **1.00**

460M. Flexible Metal Scale in Metal Case. This new scale combines the properties of a rigid measuring stick, folding rule, and steel tape in a most remarkable manner. It is made of thin steel, highly tempered and slightly concave. It is the concave, instead of the customary flat shape, that accounts for the unusual characteristics of this new measuring device. When completely or partially removed from its case, it assumes a straight form and is, therefore, suitable for making any measurement possible with a wooden ruler, meter stick or steel scale up to two meters long. Yet, it is so flexible that it can be used to measure the circumferences of cylinders as small as 1.5 inches (37.5 mm.) in diameter. This extreme flexibility permits measurements on curved and irregular surfaces and objects not possible with other types of scales. Furthermore, this extreme flexibility makes it possible to wind it into a metal case only 2 inches in diameter. Winding and unwinding is accomplished by simply pushing or pulling along the scale with one hand, while holding the cross-piece, attached to the center of the case, in the other. The scale is 2 meters long, and is graduated along one edge in centimeters and millimeters, and along the other in inches and sixteenths. In finely finished metal case **$2.25**

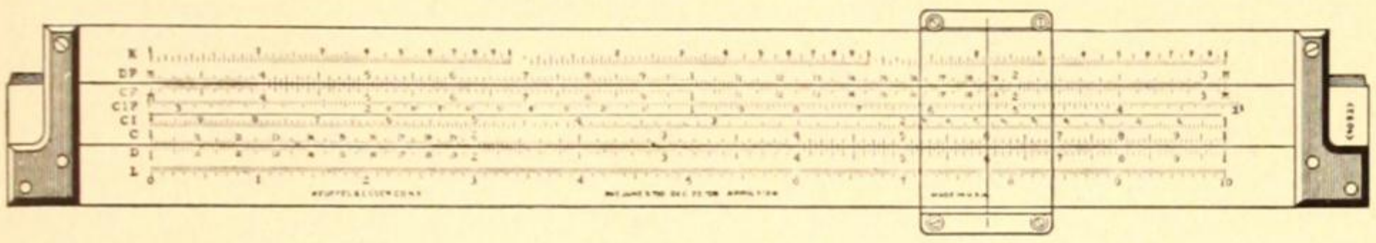
462M. Scalometer, Pocket Rule. For measuring angles, distances, heights, lengths, and widths. Made of heavy celluloid. Has two protractors 0.180° and 90-0-90°; table of scale factors 500 to 5; inclinometer scale 0 to 90°; linear scale 15 cm. long in mm.; linear scale 6 inches long in sixteenths; imprinted with full directions. Overall size 6¾x1¼ in. Complete with plumb line and bob. ..... **Each $0.50**
Per dozen **$5.00**

463M. Slide Rule. Mannheim, 10 inches long, graduations on white paper, provided with a protective coating, mounted on hardwood **$1.50**

468M. Slide Rule. Mannheim, 10 inches long, fine quality, graduations on white ivorine, glass indicator, improved automatic adjustment, in case with book of instructions **$5.00**



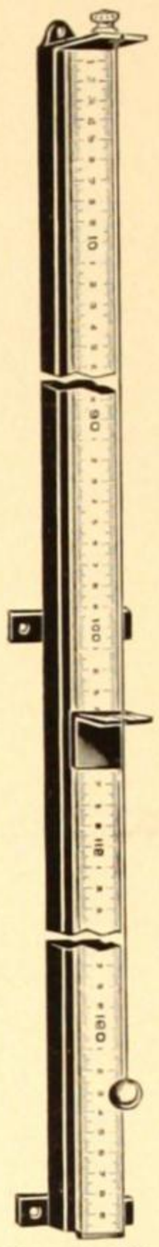
No. 469M.



No. 470M.



No. 473M.



No. 475M.

469M. Slide Rule, Polyphase Duplex, 10-inch. A combination of polyphase and duplex rules with the addition of several special scales. It is very valuable for the solution of problems involving exponentials, reciprocals and extended combinations of factors. Involved computations may be performed with a minimum number of settings, decreasing the possibility of error in reading, and reducing the time required to perform calculations. Any one of the scales may be read in connection with any other one by means of the indicator which encircles the rule.

In introducing the various changes and innovations enumerated, great care has been exercised to avoid complicating the rule, so that the Polyphase Duplex Rule can be used efficiently for the simpler problems of multiplication and division as well as for the more complicated operations encountered in the solution of various empirical formulae. In case with book of instructions **$8.50**

470M. Slide Rule, Log Log Duplex, 10-inch. This slide rule has, in addition to the scales of the Polyphase Duplex Slide Rule, a Log Log scale (representing the Logarithms of the Logarithms of a series of natural numbers) of quantities greater than unity, three fold, graduated from 1.01 to 22,000, with which any root or power of any quantity may be rapidly determined, in general by direct operation at one setting of the slide. The hyperbolic or natural logarithm of a quantity with its characteristic may be read by means of the indicator without setting the slide, or may be used directly as a factor when required in any formula.

Also a Log Log scale of decimal quantities, called LLO, which has a range of .97 to .05. It is referred to the A-B scales and is so proportioned that the hyperbolic co-logarithms of numbers on it are read directly on scale A.

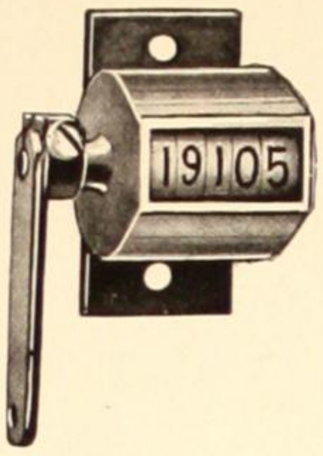
Exponentials generally, and the many formulae in electrical and mechanical engineering involving fractional powers or roots, hyperbolic logarithms, etc., are readily handled with the help of this rule. In case with book of instructions.....**$10.00**

473M. Seconds Pendulum. An inexpensive substitute for a laboratory clock. Consists of a lens-shaped iron bob 15 cm. in diameter, adjustably mounted on a metal rod. This rod is supported at its upper end on a knife edge, its lower end is provided with an adjustable contact tip. Mounted on a finely finished 15x120 cm. hardwood back provided with an improved adjustable mercury well which produces a thin edge of mercury giving a sharp contact. The wood back is also provided with binding posts for attaching battery and sounder to beat seconds audibly. This pendulum can be readily adjusted, by slightly raising or lowering the bob, to beat seconds very accurately **$12.50**

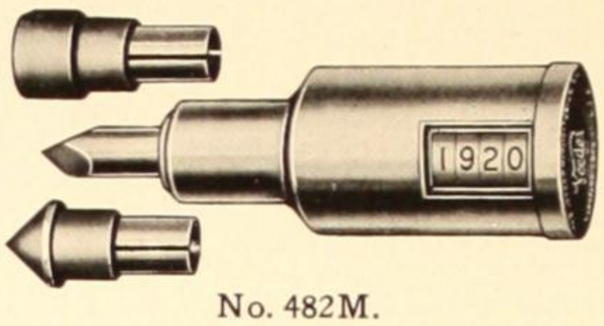
478M. Seconds Pendulum Bell. (Single stroke bell.) For use with No. 473M. An electric bell (our No. 183E) with its connections so changed that the hammer will strike the gong but once each time the circuit is closed. An inexpensive substitute for a telegraph sounder **$1.00**

475M. Pendulum, Two-Meter Adjustable Type. The hardwood scale is two meters long, graduated in millimeters and mounted upon a substantial wooden back provided with three brackets for attachment to a wall. At the upper end is a support from which the pendulum is suspended. The cord passes through a narrow slot in the slider, which can be easily and instantly moved to any position on the scale, thus providing a most convenient means for adjusting the effective length of the pendulum. The bob is of iron, 1 inch in diameter **$20.00**

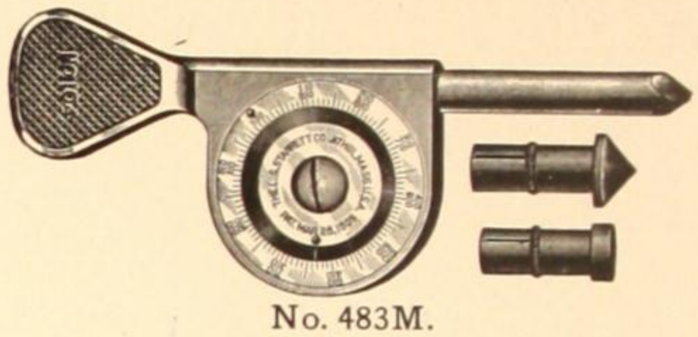
Speed Counters



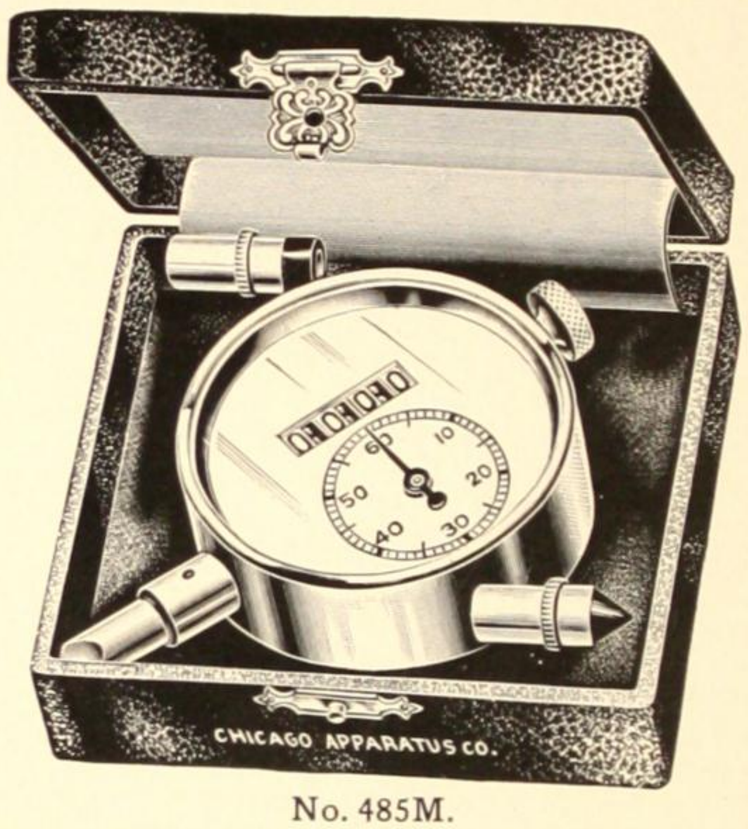
No. 481M.



No. 482M.



No. 483M.



No. 485M.

481M. Speed Counter, or Revolution Counter. Registers one for each revolution of shaft. Though small, this counter is very durable. Its mechanism will stand a very high rate of speed, making it especially suitable for light, fast running machines, and most adaptable for experimental work. Registers up to 99,999. If run backward the counter subtracts. Nickel-plated $2.00

482M. Speed Counter, or Revolution Counter With Clutch. This instrument records the revolutions made by a shaft, fly wheel, or other revolving part and may be used with an ordinary watch or a stopwatch for finding the r.p.m. The point is placed lightly against the revolving shaft; the spindle of the instrument turns freely, allowing the point to be precisely centered. A slight pressure toward the shaft engages the clutch and instantly starts the count. The instant the pressure is removed the count stops on the dot, the mechanism being automatically disengaged by the clutch. When 9,999 has been registered the count begins at zero again. Two tips for use on flat, centered and pointed shafts are provided. Nickel-plated $3.50

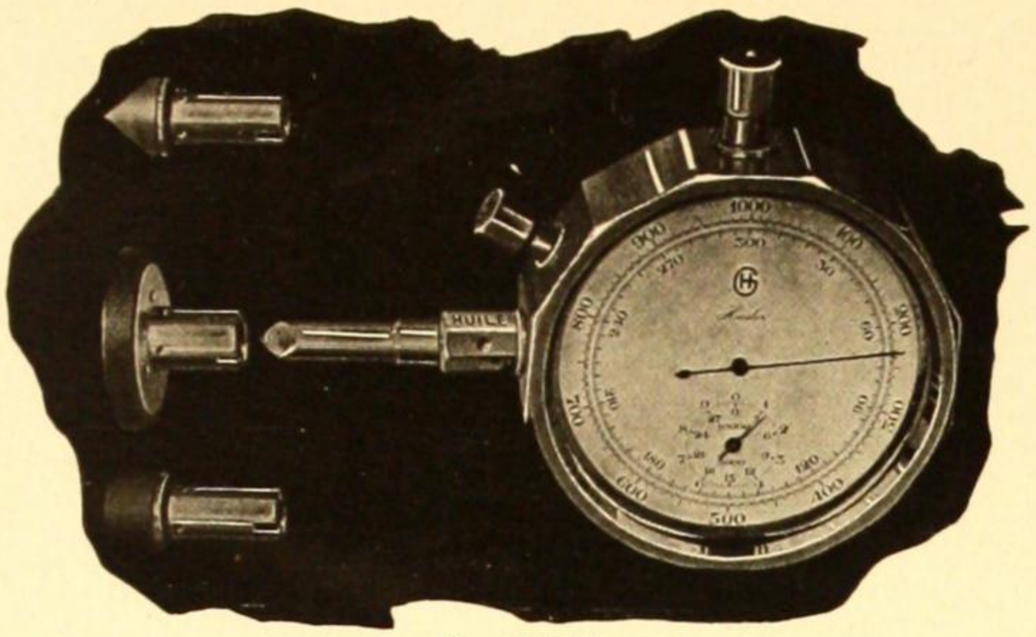
483M. Speed Indicator. For measuring the speed of motors, dynamos, rotators, etc. Reads right or left. Provided with tips for pointed and for centered shafts $1.35

485M. Speed Indicator and Stopwatch Combined. A satisfactory and inexpensive instrument for the direct measurement of motor, dynamo, rotator and other speeds.

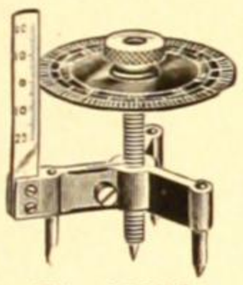
Special Features

1. Counter and stopwatch start and stop simultaneously.
2. Indicates r.p.m. directly when operated for exactly one minute.
3. Indicates average speed over any period of time up to 65 seconds.
4. Can be used as a revolution counter—reads up to 10,000.
5. Can be used as a stopwatch for timing intervals of from 1 to 65 seconds.
6. Only one stem to turn to reset watch and counter to zero and to rewind watch.
7. Works in either direction.
8. Accurate, rapid, durable, compact.

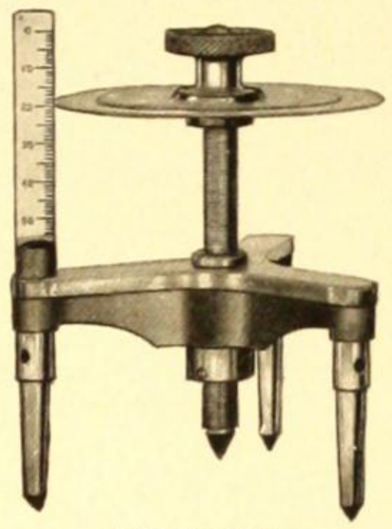
The instrument is finely nickel-plated and comes complete in a velvet lined case with tips for pointed and centered shafts $12.50



No. 488M.



No. 493M.



No. 494M.

488M. Speed Indicator, Hasler. (Precision Type.) A fine watch movement and a geared revolution counter, synchronized and combined so that when the spindle is in contact with a revolving shaft, and the button located on top of the instrument depressed, the pointers are automatically started and disengaged after a period of 3 seconds. The pointers remain in the reading position as long as desired and the speed (R.P.M.) is noted by reading the black figures.

To measure circumferential speed (feet per minute)—say of a pulley—the small disk wheel is slipped onto the spindle and placed in contact with the face of the pulley. The F.P.M. is then noted by reading the red figures.

The Hasler has many advantages—no stop watch needed—but one operation to perform—unprecedented accuracy—wide speed range—extreme ease of reading—remarkable durability—not influenced by external forces—works in both directions of rotation—weighs but 10 ounces—and is very compact.

This instrument has a direct reading range from 0 to 10,000 R.P.M. and will measure any speed within its range to within 2 R.P.M. Complete, with three tips, as illustrated; in neat carrying case, size 4x1½x5¼ inches **$65.00**

489M. Speed Indicator, Hasler. (Precision Type.) Same as No. 488M, but with a direct reading range from 0 to 1,000 R.P.M. Measures any speed within its range to within 1/5 of a revolution..... **$70.00**

493M. Spherometer, Students'. For laboratory work requiring only a fair degree of accuracy. The screw has a range of 20 mm. with vertical scale graduated to correspond. Screw diameter—6 mm.; pitch—0.1 mm.; head diameter—40 mm.; number of head divisions—100. Reads direct to 0.01 mm. and by estimation this can be carried to 0.002 mm. Radius of base circle—25 mm. **$5.00**

494M. Spherometer, Precision Type. Of the best workmanship and especially designed for laboratory work. The screw is accurately cut and well corrected. Its range is 20 mm. with vertical scale graduated to correspond. Screw diameter—6 mm.; pitch—0.5 mm.; head diameter—50 mm.; number of head divisions—100. Reads direct to 0.005 mm. and by estimation this can be carried to 0.001 mm. Radius of base circle—25 mm. **$32.00**

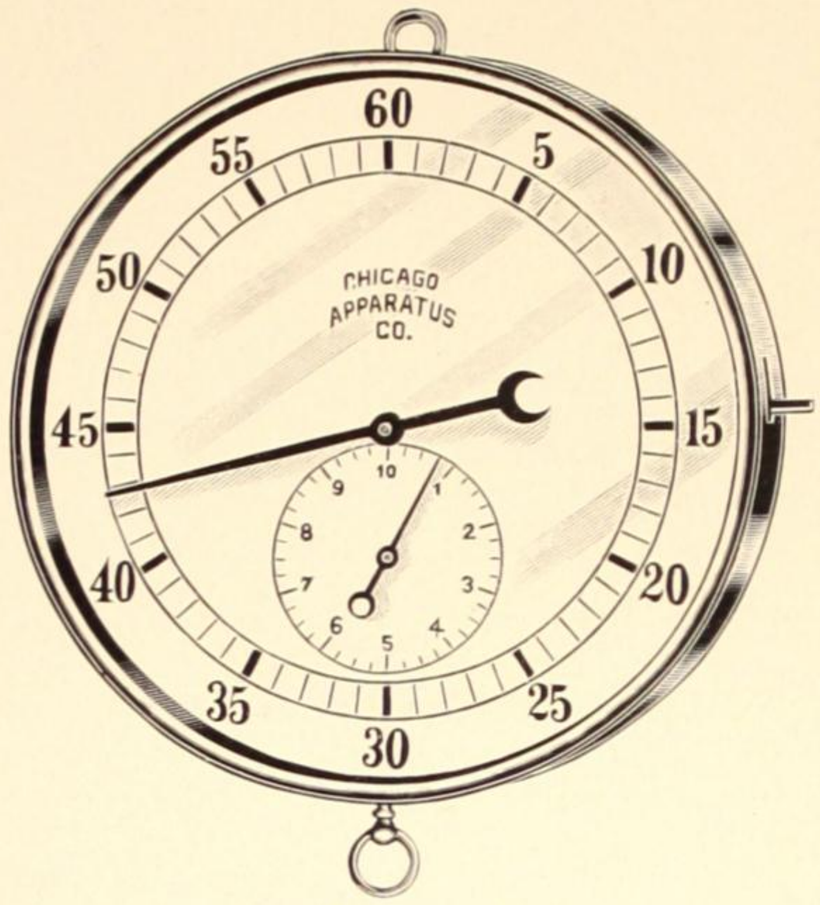
495M. Spherometer, Precision Type. Similar to No. 494M, but larger and more accurate. Screw has a range of 50 mm. with vertical scale to correspond. Screw diameter—10 mm.; pitch—0.5 mm.; head diameter—90 mm.; number of head divisions—250. Reads direct to .002 mm. and by estimation this can be carried to .0004 mm. Radius of base circle—50 mm. **$50.00**

Note: Formula for obtaining the radius of lens curvatures with spherometer is as follows:

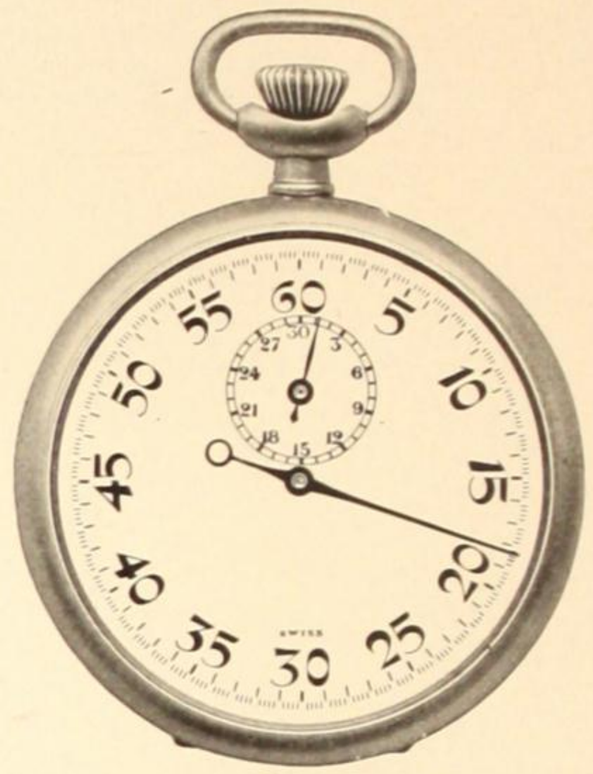
$$R=\frac{r^2-d^2}{2d}$$

r = Radius of spherometer base circle.
d = Reading of spherometer screw.

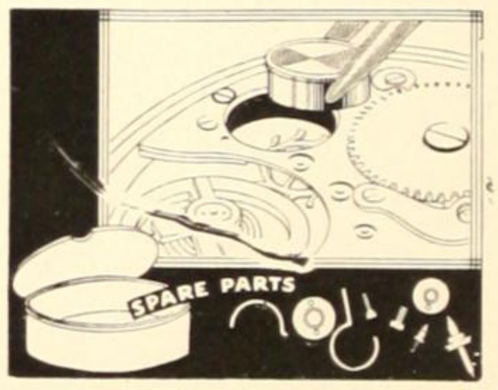
Stop Clock and Stop Watches



No. 497M.



No. 498M.



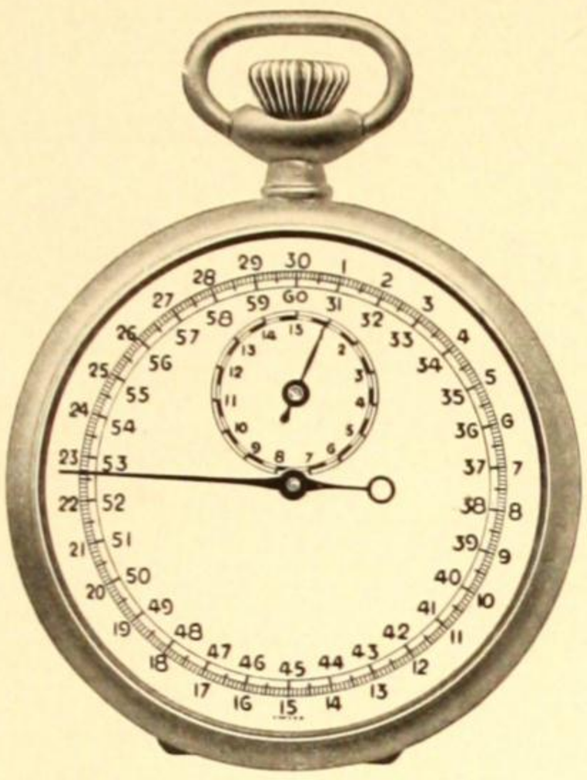
Spare parts for Stop Watches.
(See note at bottom of page).

497M. Stop Clock. This clock is in reality a large stop-watch. It is started, stopped and reset in the same manner. It is 21 cm. in diameter and, therefore, visible to everyone in a large class. It is invaluable for obtaining the total time of a series of oscillations, swings, or cycles as a basis for the accurate determination of periodic time. It is also excellent for checking other laboratory processes and operations, such as timing the flow of liquid period in viscosity experiments, the flow of current period in electric calorimeter experiments, the exposure period in photo and blue printing, etc. Dr. R. S. Minor recommends its use in his experiment on the Radius of Gyration.

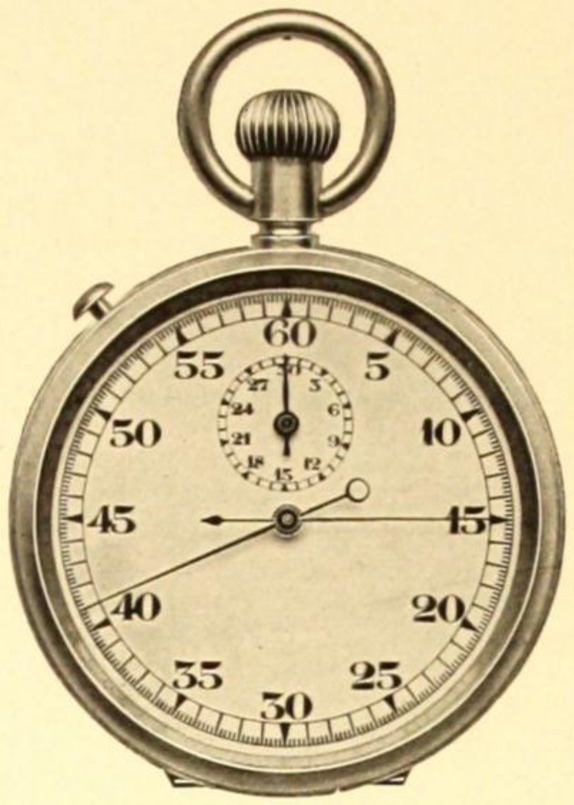
The large outside dial indicates seconds up to 60 seconds, then repeats; the small inside dial registers up to 10 minutes, then repeats. Runs for 36 hours on one winding. The winding is done with a fixed key at the back. The timer is started by lifting the side lever and stopped by moving the same lever down. Pulling down on the lower ring returns both hands to the starting point. By attaching cords to the side lever and lower ring, the timer can be operated from various distant points in a laboratory. In this event the pull on the cords is directed by means of suitably placed pulleys of small size. In finely nickeled case with suspension ring **$18.75**

498M. Stop-Watch, Single Action 1/5th. Split-Second Type. For accurately timing a single performance. Standard make, nickeled case, 7-jewel non-magnetic movement, thirty minute register, stem wind and lever escapement. Records 1/5th seconds. A push on the crown starts the hands, a second push stops them, and a third push causes them to fly back to zero **$12.00**

NOTE: In all our stop watches, a special compartment is built into the movement. This carries extra or spare parts that will prove useful and time saving when repairs become necessary. This feature makes it possible for your local jeweler to service our stopwatches economically and without delay.



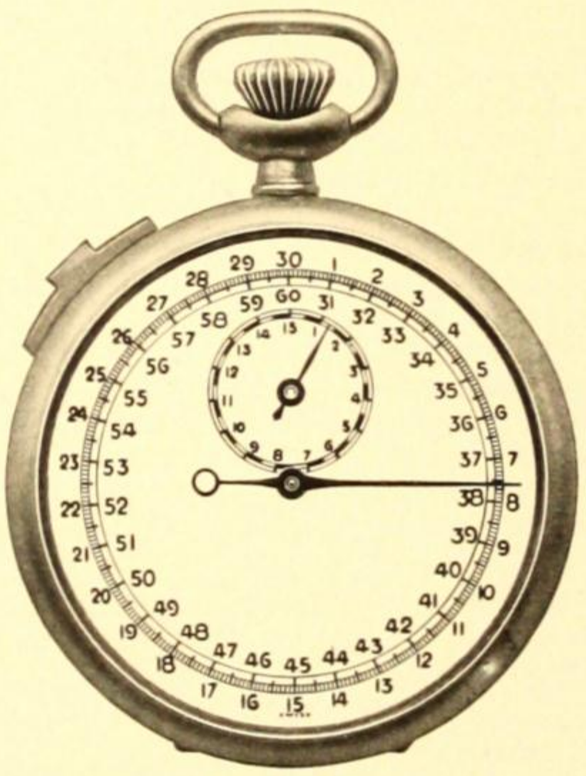
No. 498Ma.



No. 499M.



No. 500M.



No. 500Ma.

498Ma. Stop-Watch, Single Action 1/10 Split-Second Type. Same as No. 498M, but designed to record 1/10th seconds. The small dial registers up to 15 minutes, then repeats. This watch is to be preferred where greater accuracy of timing than is possible with ordinary stopwatches is desirable..**$19.50**

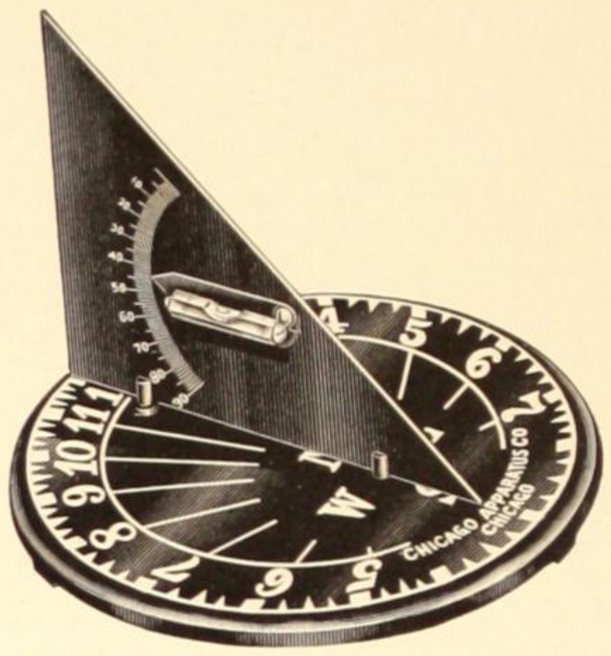
499M. Stop-Watch, Double Action 1/5th Split-Second Type. Same general construction as No. 498M, but arranged for timing two events which start at the same time, but end at different times. A push on the crown starts both hands, a second push stops one hand, and a third push stops the other. A push on the side-piece causes both hands to fly back to zero. Useful in inclined plane and pendulum experiments and in timing first and second places in races. Records 1/5th seconds. The small dial registers up to 30 minutes, then repeats.....**$30.00**

500M. Stop-Watch, Interruption 1/5th Split-Second Type. Same general construction as No. 498M, but arranged for timing an interrupted performance, excluding the time of interruption. A push on the crown starts the hands, a second push stops them, a third push starts them again, etc. A push on the side-piece causes the hands to fly back to zero. Records to 1/5th seconds. The small dial registers up to 30 minutes, then repeates.....**$13.50**

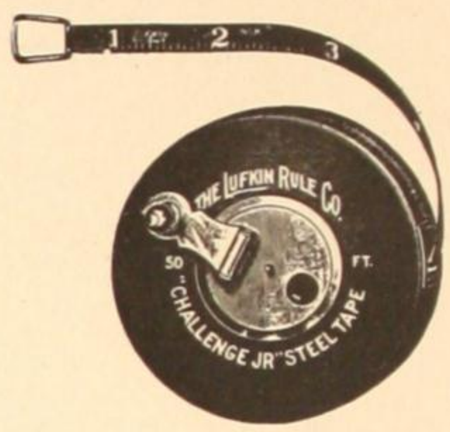
500Ma. Stop-Watch, Interruption 1/10th Split-Second Type. Same as No. 500M, but designed to record 1/10th seconds. The small dial registers up to 15 minutes. This watch is to be preferred where greater accuracy of timing than is possible with ordinary stopwatches is desirable.....**$20.50**



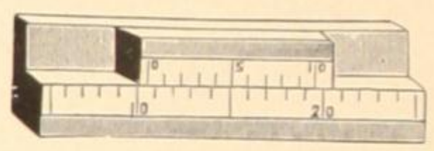
No. 501M.



No. 503M.



Nos. 504M-507M.



No. 508M.

501M. Universal Sun Dial with Compass. This beautiful instrument is for determining Sun Time anywhere in the world, from the equator to the poles. It is designed for use in the classroom, office or home, but not for continued exposure to outdoor weather conditions.

A **Jeweled-Bearing Compass** is mounted in a recess in the base and is provided with a needle-release pin extending through the edge of the base. The compass is a great convenience in bringing the instrument in adjustment with the plane of the meridian.

A **Latitude Pointer,** attached to the end of the bearing arm, gives the latitude reading on the latitude scale as the gnomon and hour dial are adjusted. The silvered latitude scale being graduated from 0° to 90° makes its use possible anywhere from the equator to the poles.

The **Silvered Hour Dial,** with black graduations and numerals, shows the hours, half hours, and quarter hours from 4 A.M. to 8 P.M. Readings to closer intervals can be made by estimation.

The **Nickel Silver Gnomon** is non-corroding, and is stretched, under tension at right angles to the plane of the hour dial, passing through its geometric center. This arrangement, which makes an Equatorial Sun Dial, permits reading sun time in any part of the world when the instrument is correctly set up and oriented.

The **Finish** is gun metal, with silvered dials and brass screws, and the whole is lacquered to prevent corrosion. The base diameter is 9 cm.; total height, 18.5 cm. In neat wooden box with full directions, table of equation of time values for every day in the year, and a chart of compass declinations throughout the United States.....**$16.00**

503M. Sun Dial, Universal. The dial is of Japanned metal, 25 cm. in diameter, and is of substantial construction. The gnomon is of brass, and is provided with a spirit level and a graduated arc for indicating the correct setting for any latitude. The instrument can therefore be used with good results in any locality. A variation curve which reads directly the variation between sun time and mean solar (clock) time for every day in the year is supplied with each instrument **$8.00**

504M. Tape, Measuring, English and Metric. Linen, ½ inch wide, graduated one side in centimeters and other side in feet and inches; length 66 feet; enameled case, with folding rewind handle.....**$2.00**

505M. Tape, Measuring, Linen, English. Extra durable tape, well-coated. Steel case brass bound, with sides maroon enameled. Brass folding handle and trimmings. Tape is ½ inch wide, graduated in ½ inches.

Length, feet	50	100
Each	**$1.50**	2.25

506M. Tape, Measuring, Steel, English. About half the weight of other tapes of equal length. Very convenient to carry anywhere. Marked so instantaneous readings in feet, inches, and sixteenths are possible at any point on the tape. Re-enforced russet leather case. Folding flush handle opened by pressing pin on opposite side. Tape is ¼ inch wide, graduated in feet, inches and sixteenths.

Length, feet	50	100
Each	**$7.00**	**10.00**

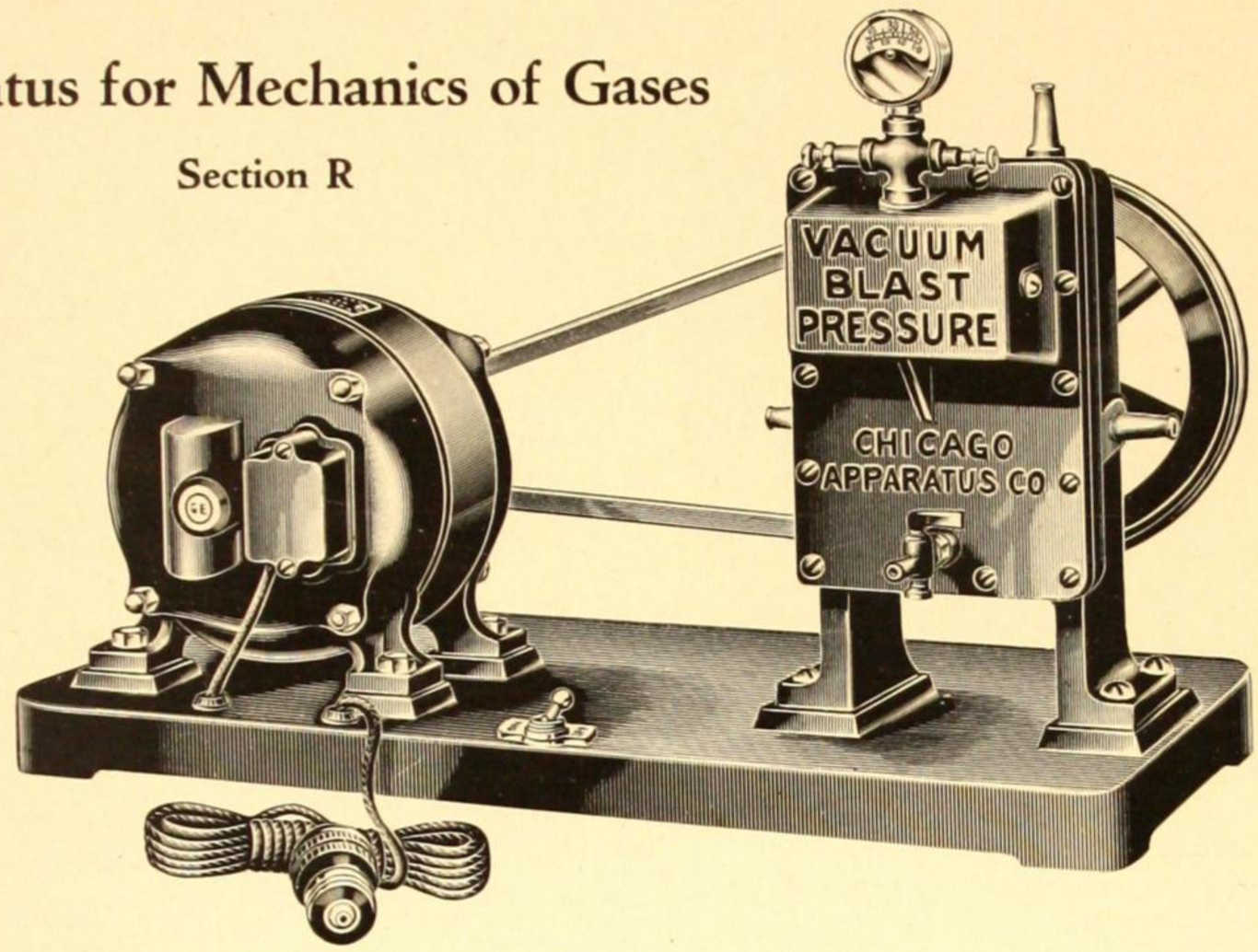
507M. Tape, Measuring, Steel, English and Metric. Nickel silver case, spring wind, center stop. Tape ¼ inch wide, graduated to 16ths of an inch on one side, millimeters on the other.

Length	...36 inches (1 meter)	72 inches (2 meters)
Each	**$1.00**	**1.50**

508M. Vernier Model. Large size, half meter long. The long scale is graduated in centimeters; the vernier has ten divisions so that it is possible to read to tenths of centimeters (millimeters). Made of hardwood, neatly finished.....**$2.50**

Apparatus for Mechanics of Gases

Section R



No. 4410R.

THE NEW NELSON ROTARY PUMP
(Vacuum-Blast-Pressure)

This rapid and efficient rotary pump, designed by Mr. George F. Nelson, University of California, surpasses all other types in mechanical construction and reliability of performance. It is rapidly replacing other makes and now forms part of the regular equipment of many large university and industrial laboratories. Its construction is very simple, consisting of a single rotor of elliptical shape with two swing shutters or vanes nicely timed relative to suction and discharge. The simple mechanism is enclosed in an iron case and operates completely submerged in a special oil. A check valve prevents flow of oil into the vacuum line. As a **Vacuum Pump** it is suitable for all regular laboratory work requiring pressure down to .01 mm. Vacuum distillation, backing up mercury pumps, and demonstrating electrical discharges through gases are some of the special uses it may be put to. Two of these pumps connected in series will produce a vacuum of .0001 mm. As a **Blower** it will operate several blast lamps or torches. As a **Pressure Pump** it is well adapted for the collection of gases, as it is entirely sealed for pressures up to 50 pounds. The pressure outlet is equipped with a gauge reading to 60 pounds with spring and ball regulating valve.

Specifications

Degree of vacuum	.01 mm.
Capacity of free air per minute at 200 R.P.M.	200 cu. in.
Pressure gauge reads to	60 lbs.
Pressure valve regulates to	50 lbs.
Size of pump only	5½x6x8½ in.
Size of wood base required for mounting pump and motor	9x20 in.
Power required for pressure of 5 to 20 lbs.	1/6 H.P.
Power required for pressure of 25 to 50 lbs.	1/4 H.P.
Power required for vacuum alone	1/6 H.P.
Best speed for motor	1100-1200 R.P.M.
Proper speed for operation of pump	200-250 R.P.M.
Size of pulley grooved for $\frac{5}{16}$-inch belt	6½ in.
Weight of pump with oil	18 lbs.

Furnished in three styles—Unmounted—On Metal Base—With Motor Drive.

4400R. Nelson Rotary Pump, Unmounted. Provided with 60-lb. pressure gauge, 7½ inch pulley grooved for $\frac{5}{16}$-inch round belt or V-shaped vulcanized, stretchless, endless belt. Including supply of vacuum oil, vulcanized endless belt, and directions **$40.00**

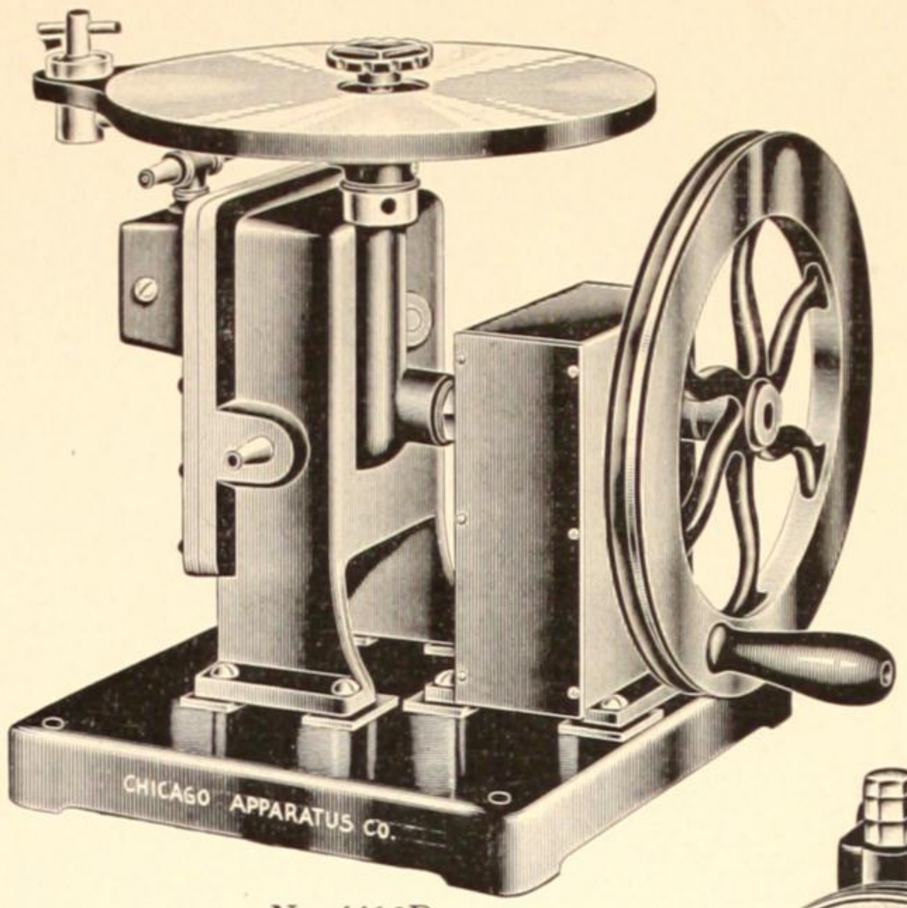
4405R. Milvay-Nelson Rotary Pump on Metal Base. Same as No. 4400R, but on black enameled iron base, 50x24.5 cm., with holes for attaching motor. Including vulcanized stretchless, endless belt, but without motor **$44.50**

4410R. Milvay-Nelson Rotary Pump With Motor Drive. On black enameled iron base, with 1/6th H.P. motor, vulcanized endless belt, tumbler switch on base, and cord with plug. For use on 60 cycle, 110-volt A.C. circuits **$74.50**

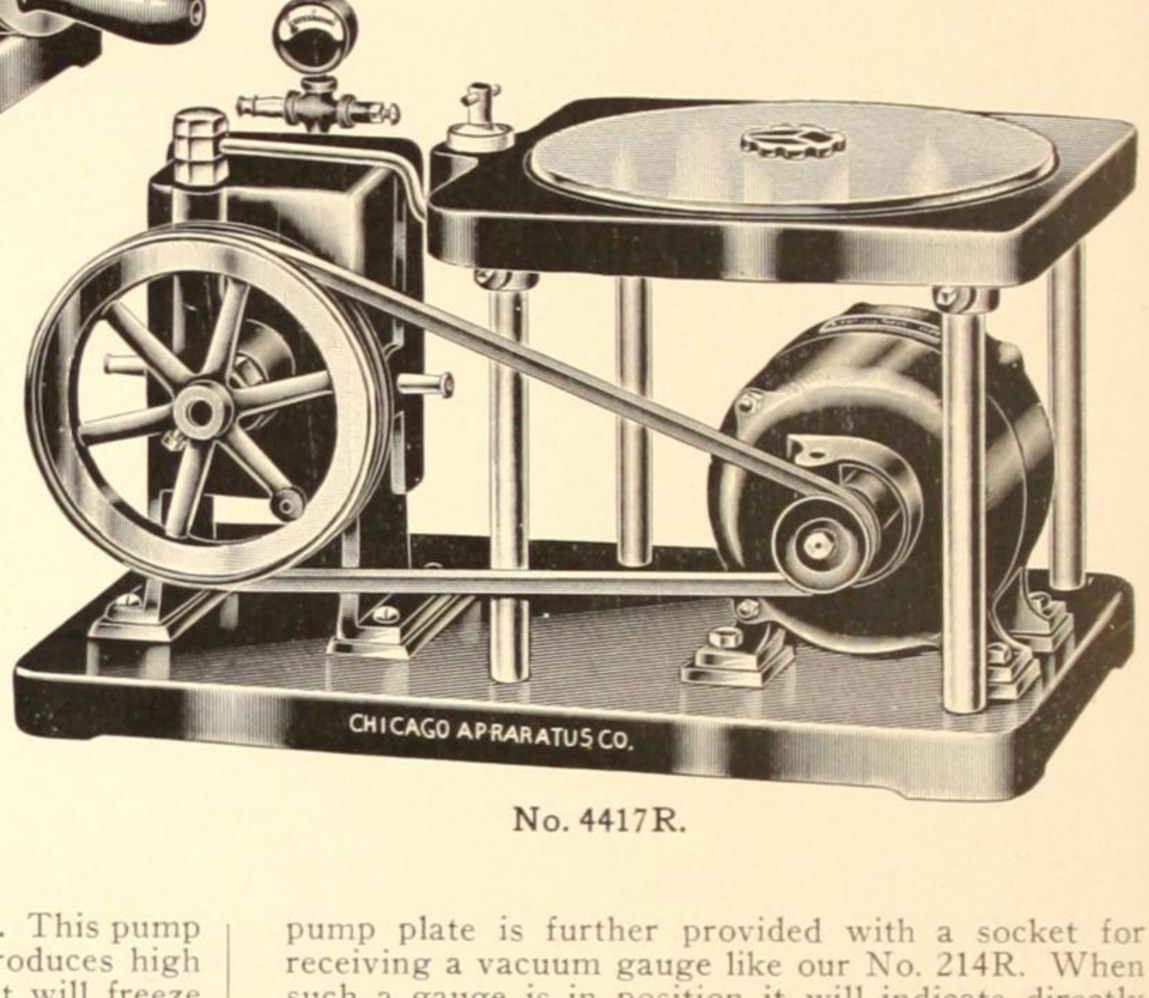
4411R. Milvay-Nelson Rotary Pump with A.C. Motor Drive. Same as No. 4410R but for use on 25 cycle, 110-volt A.C. circuits **$79.50**

4415R. Milvay-Nelson Rotary Pump with D.C. Motor Drive. Same as No. 4410R but for use on 110-volt D.C. circuits **$77.00**

NOTE: We recommend our No. 20R Air Pump Plate for use with the above pumps.



No. 4416R.



No. 4417R.

4416R. Milvay-Nelson Lecture Air Pump. This pump is unexcelled for lecture purposes. It produces high vacuums—up to .01 mm. of mercury. It will freeze water in three to four minutes. It also produces pressures up to 50 lbs. Since its few working parts are at all times immersed completely in oil, it is always ready for service regardless of how long it may have stood idle. It is compact, convenient and portable. It is very efficient and very rapid as is indicated by the fact that it will pass 200 cubic inches of free air per minute at 200 R.P.M. It is noiseless and extremely easy to operate.

This new combined vacuum and pressure pump consists of a No. 4400R Nelson Rotary Pump mounted upon a black enamelled base and provided with hand drive and pump plate. The drive is through two inclosed silent gears, providing extremely smooth action and ease of operation. The pump plate, of metal, is 10 inches in diameter and its top surface is ground perfectly flat. All standard air pump attachments will fit the center opening which is tapped $\frac{7}{16}$-16. To protect the threads of this central opening against injury, to keep dust and other foreign matter out of the pump, and to provide a suitable support for bursting cubes, mercury dishes, etc., this opening is provided with a special removable guard plug having a top diameter of 50 mm. The pump plate is further provided with a socket for receiving a vacuum gauge like our No. 214R. When such a gauge is in position it will indicate directly the pressure within the vessel being evacuated in millimeters of mercury.

When desired this pump may also be electrically operated. For this purpose, the wheel is grooved to fit a $\frac{5}{16}$ inch round leather belt and our No. 4430R vulcanized belt. The base is provided with 4 screw holes for fastening to a suitable board. A 1/6 H.P. motor will provide sufficient power for pressures up to 20 lbs.; while a 1/4 H.P. motor will be necessary if pressures up to 50 lbs are desired. When operated only as a vacuum pump a 1/6 H.P. motor will suffice.

The pump is very compact. The base measures 28x29 cm. and the overall height is 36 cm. Drive wheel and plate are both 25 cm. in diameter. The pump is readily portable, weighing but 50 lbs. Complete with supply of oil.....**$75.00**

4417R. Milvay Electrically-Operated Lecture Air Pump. This new and complete unit provides a most convenient, compact and efficient vacuum and pressure pump for lecture demonstration and general laboratory work.

In vacuum experiments, involving the use of apparatus under bell jars, such as in freezing of wa-

ter—buoyancy of air by the baroscope method—pressure of air by the hand and bladder glass method—principle of the mercury barometer—expansive force of air by the bursting cube or rubber balloon method, etc., the built-in, permanently-connected pump plate will prove a great convenience. In experiments requiring the use of apparatus that must be screwed into the center socket—such as in air pressure by means of Magdeburg hemispheres—fountain in vacuo—electrical discharge in vacuum—guinea and feather experiment—weight of air—etc., the built-in permanently-connected pump plate is a decided advantage. It eliminates the inconvenience of the separate plate with its temporary rubber tube connection of doubtful air-tightness.

For exhausting apparatus, which can only be connected to an air pump by means of rubber tubing—such as McLeod gauges—electric discharge tubes—weight of air flasks—etc., a special brass hose end to be screwed into the center plate socket is provided.

In addition to vacuum work, this pump is also useful as a blower for operating blast lamps, organ pipes, the filling of compressor tanks, etc. For this purpose a convenient brass hose end, located directly under the pressure gauge, is provided.

The pumping unit employed is the latest improved rotary Nelson type completely submerged in oil and, therefore, absolutely leak-proof. It is very efficient, very rapid and practically fool-proof. The pumping chamber is provided with unusually large inlet and outlet ports. As a result, any mercury, glass chips or other foreign particles drawn into the pump can do no harm, as they are promptly ejected from the vacuum chamber into the oil bath surrounding this chamber. Here they gradually settle into a reservoir, from which they can be withdrawn at any time by opening the stopcock at the lower end of the pump housing.

Additional oil is rarely required for none is consumed in operation. When needed it can be quickly added through the filler plug in the top of the case. An overflow in the side of the case, closed when not in use, serves as an accurate index to the correct oil level.

In addition to its fool-proof qualities, this new pump is quiet in operation, rapid, rugged in construction, compact, absolutely positive in its vacuum and compression action, efficient and dependable for continuous or intermittent work. These qualities fit it most admirably for the wide variety of service demanded in lecture and general laboratory work.

Specifications

Maximum degree of vacuum.....01 mm.
Capacity of free air per minute at 200 R.P.M. .....200 cu. in.
Maximum pressure per sq. in.....25 lb.
Diameter of ground glass pump plate.....25 cm.
Size of base.....31x52 cm.
Overall height .....34 cm.

The ground glass pump plate is mounted in a cast iron mold supported on four nickel-plated rods. The center socket is of the oil-sealing type and is tapped $\frac{7}{16}$-16—the standard for all air-pump accessories. A No. 165R Guard Plug and No. 209R Hose End for use in this center socket are also supplied. A second socket, also of the oil-sealing type and normally closed with a solid removable plug, permits the insertion of a vacuum gauge, or manometer, like our No. 214R in the vacuum line. A gauge on top of the pump housing indicates pressures per square inch when the pump is used as a blower or compressor. The permanent connection between pump and plate is a heavy nickel-plated copper tube with metallic leak-proof joints. The base is of cast iron and, like other iron parts, is finished in non-chipping, gloss black enamel. The motor is a heavy-duty type for operation on 110-volt, 60-cycle current.

Complete, with connecting cord and supply of vacuum oil **$100.00**

4418R. Milvay Electrically-Operated Lecture Air Pump. Same as No. 4417R, but for use on 110-volt D.C. current **$102.50**

4419R. Milvay-Nelson Electrically-Operated Air Pump. Same as No. 4417R, but for use on 25 cycle, 110-volt A.C. circuits.....**$105.00**

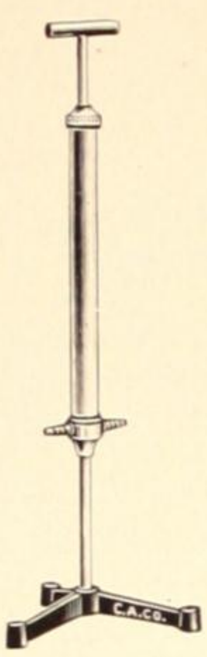
4420R. Nelson Pump Oil. Per quart.....**$0.50**

4425R. High Vacuum Rubber Tubing. A special extra heavy wall, pure gum tubing for air pump connections, filter connections, mercury leveling bulbs, and high vacuum work. It is air-tight, gas-tight, and "clings" to inlets, outlets, and glass tubing. Its specific gravity is under 1.00 and because of the formula and method of curing employed will give years of service.

No.	A	B	C
Bore, inches	1/8	3/16	1/4
Wall thickness, inches.....	3/32	3/16	3/16
Per foot	**$0.20**	**.30**	**.35**

NOTE: Sold only in 3, 6, 9 or 12 foot lengths.

4430R. Exra Belt. For replacement on Nos. 4410R, 4411R, 4415R, 4417R, 4418R and 4419R. Of vulcanized fabric and rubber, V-shaped, endless, and stretchless **$1.50**



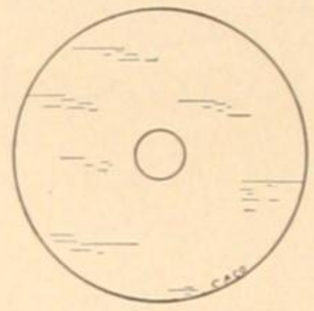
No. 9R.



No. 14R.



No. 19R.



No. 23R.



No. 20R.



No. 22R.

9R. Air Pump, Vacuum and Pressure. Gives satisfactory results in elementary work. Nickel-plated brass cylinder, 28x2.5 cm.; two improved easy acting valves; tapered serrated hose ends for $\frac{5}{16}$-inch bore rubber tubing. Mounted on black enameled tripod support. (Air Pump Plate for use with this pump is listed under No. 19R) **$5.00**

10R. Air Pump, Vacuum and Pressure. Same as No. 9R, but mounted on clamp (instead of tripod) for fastening to edge of table, making it very convenient for lecture and demonstration work. (Air Pump Plate for this pump listed under No. 19R) **$5.00**

14R. Air Pump, Vacuum and Pressure. Large nickel-plated brass cylinder 45x5 cm., two easy-acting silk valves, improved plunger, mounted on metal stirrup. A quick-acting pump which produces a vacuum sufficient for all elementary experiments in physics. (Air Pump Plate for use with this pump listed under No. 19R) **$12.00**

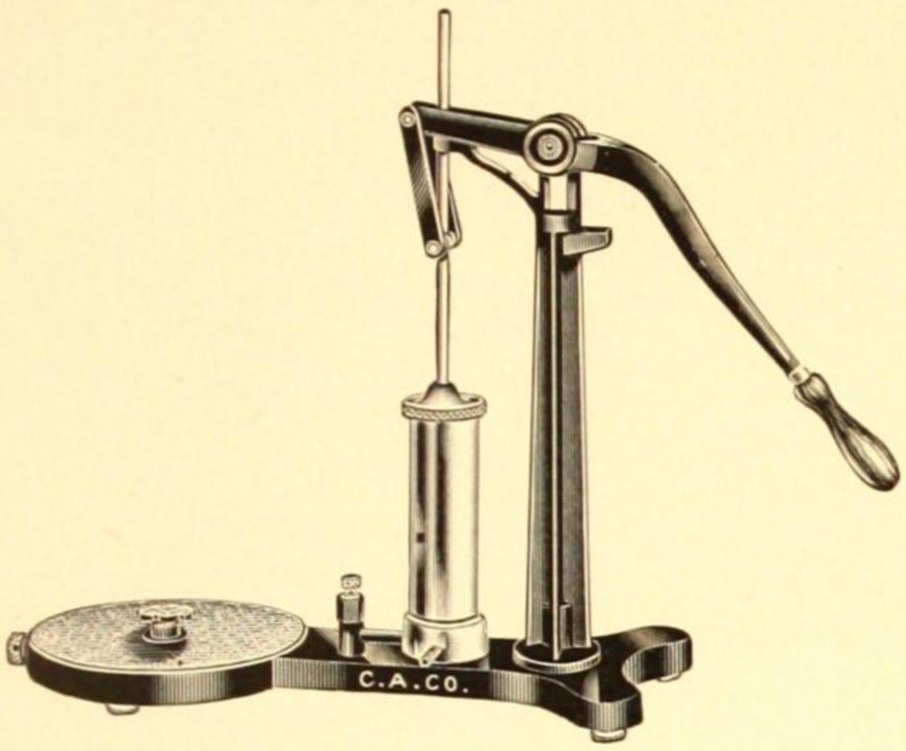
19R. Air Pump Plate. For use with No. 9R or No. 14R Air Pump. Cast iron stand, top surface, 22.5 cm. in diameter, ground plane to insure perfect contact with bell jar flange. Hose end of stopcock fits $\frac{5}{16}$-inch bore rubber tubing. Manometer tap, located just back of the stopcock, is closed by a removable solid plug. Vent hole at center is tapped standard ($\frac{7}{16}$-16) for all air pump accessories and is provided with a removable Milvay Guard Plug. The advantages of the latter are described under No. 165R **$6.50**

20R. Air Pump Plate, Milvay Oil-Sealed Type. Provided with recesses about the inlets and center vent which, when filled with oil, makes this pump plate absolutely leak proof and therefore suitable for vacuum work of the highest order. The surface of the heavy glass disk—25 cm. in diameter—is ground perfectly true. The iron base into which the disk is sealed is extra heavy and finished in black enamel. The two inlets, one for air, the other for manometer, are provided with removable solid plugs. The center vent is provided with a removable No. 165R Improved Milvay Guard Plug. Vent and inlets are tapped $\frac{7}{16}$-16 and therefore fit all air pump accessories **$17.50**

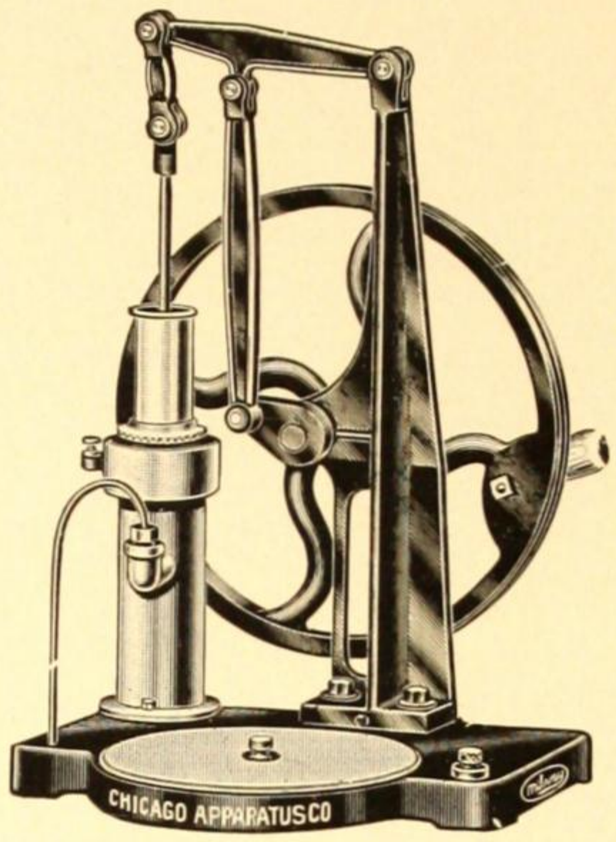
21R. Pressure Tubing, 3 Feet Long, $\frac{5}{16}$-Inch Bore. For connecting air pumps with pump plates. Will not collapse under a vacuum and is absolutely air tight **$0.60**

22R. Pump, Hand Pressure. Small nickel-plated hand bicycle pump, suitable for compressing air into football bladders, weight of air globes, air pressure chambers, etc. Also excellent for illustrating how, in compressors, a flexible concave leather disk is made to serve as both piston and intake valve. Length of barrel, 15 cm. **$0.50**

23R. Sealing Pad, Rubber. A thick soft rubber pad, 24 cm. diameter, for sealing bell jars and bladder glasses to pump plates. Absolutely prevents leakage even when surface of pump plate and flange of jar are not perfectly true. Eliminates the use of oil, grease, or vacuum wax. This pad has for several years been successfully used in European laboratories and for its listing we are indebted to Prof. N. Henry Black, Roxbury, Latin School, Boston, Mass. **$2.25**



No. 24R.



No. 29R.

24R. Air Pump, Vacuum and Pressure, Lever Action Type. Polished brass cylinder, 63 mm. diameter, 21.5 cm. long; two easy-acting silk valves; heavy glass pump plate, 25 cm. diameter, ground plane and sealed in an iron mold. Vent hole at center, tapped $\frac{7}{16}$-16, fits all standard air pump accessories and is provided with a removable Milvay Improved Guard Plug. (See No. 165R.) Base and pillar are of iron, neatly finished in black Japan.....**$35.00**

29R. Air Pump, Vacuum, Geryk Type, Milvay Improved Design. Offers three distinct advantages over other makes, either domestic or foreign:

First: A Higher Vacuum—.008 mm. guaranteed. Tests with a McLeod Gauge show vacuums as high as .005 mm. are easily reached with this new pump.

Second: No Splashing of Oil. This as accomplished by the new type of top cylinder construction.

Third: Greater Durability. This is accomplished by encasing the entire lower section of the cylinder in a single heavy brass casting. In older models this lower section is built up from numerous separate parts with no less than seven external joints. It is extremely difficult to seal so many joints against leakage. Besides, they cannot stand the continuous strain imposed on them by the operation of the pump. The danger of leakage is therefore ever present. Furthermore, so many joints weaken the cylinder. Should a joint open up the pump is rendered useless, necessitating its return to the factory for costly repairs. All these disadvantages are overcome by our new construction. There is not a single external joint to leak or open up. That's why this improved Milvay Geryk Pump produces a higher vacuum than older models. The construction is so sturdy and strong that a lifetime of service is absolutely assured.

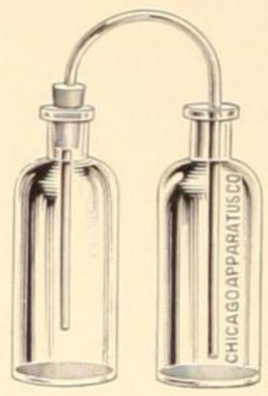
There are no valves in the ordinary sense of the word. The piston works in oil which seals the inlet and outlet ports. The glass pump plate with its perfectly ground surface is 25 cm. in diameter and sealed in the base. All other parts are substantially constructed of cast iron and brass, and finely finished. The opening in the center of the plate is provided with a standard $\frac{7}{16}$-16 thread that will fit all standard air pump accessories. This opening is provided with a removable guard plug which prevents the entrance of mercury, glass chips and other undesirable substances, yet permits the free passage of air. At the right hand end of the base is an opening for attaching a vacuum gauge such as our No. 214R. When the gauge is not employed, this opening is closed with the solid plug furnished. Diameter of piston 48 mm., length of stroke 9 cm., operated by hand wheel. The face of the wheel is so designed that the pump may be operated by motor power if desired. A $\frac{1}{8}$ H.P. Motor used with countershaft No. 31R will drive this pump at the correct operating speed—about 60 r.p.m. Provided with Milvay Removable Guard Plug the advantages of which are described under No. 165R.....**$60.00**

31R. Countershaft. For use in operating No. 29R Air Pump with an electric motor.....**$7.50**

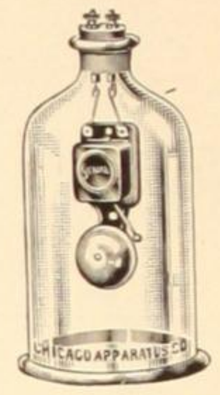
AIR PUMP ACCESSORIES



No. 34R.



No. 33R.



No. 39R.



No. 40R.



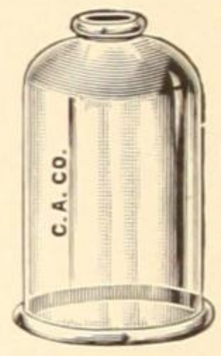
No. 44R.



No. 46R.



No. 48R.



No. 49R.



No. 50R.

33R. Air Expansion Apparatus. Two 250 cc. bottles connected by a bent glass tube. One bottle is open; the other is closed air-tight with a rubber-stopper. When both bottles are partially filled with water, placed under a bell jar and the air exhausted, water flows from the closed to the open bottle through the connecting tube. When air is admitted flow is reversed. Shows expansibility of air.....**$0.60**

34R. Baroscope. For showing the upward pressure or buoyancy of air. Consists of a sealed hollow glass globe with hook, counterpoised on a sensitive beam balance with metal stand. The glass globe undergoes no change in shape or weight, hence, no readjustment of the counterpoise is every necessary as in brass globe and cork ball types. For use under No. 46R Bell Jar, two gallon size. Without bell jar **$7.50**

39R. Bell in Vacuum, New Form. For showing that sound is not transmitted through a vacuum. Consists of an open-top, bell jar, inside height 28 cm., inside diameter 15 cm., and a snug fitting rubber stopper provided with binding posts and terminals from which an electric bell is suspended. Fits any air pump plate 17.5 cm. or more in diameter. Complete with bell **$4.50**

40R. Bell in Vacua, Bottle Type. For showing that sound waves are not transmitted by a vacuum. Consists of a small bell so mounted on the end of a flexible reed that its clapper will strike the bell when the bottle is shaken. The bottle is 4000 cc. in size and is provided with stopper and stopcock. Fits any pump plate. This design is intended to be removed from the pump after evacuation and to be passed about the class so that each student may test for himself the effect of the absence of the transmitting medium on sound.....**$3.00**

Bell Jars

All of our bell jars are made of heavy clear glass. The rims are reground and tested to insure good contact with the pump plate.

44R. Bell Jar. (Hand and Bladder Glass.) Low swelled form, open to top, both rims ground. Diameter 7.5 cm., height 12.5 cm.....**$3.00**

310S. Bladder. Prepared and Cleaned. For use with No. 44R Bladder Glass to show bursting by atmospheric pressure **$0.20**

46R. Bell Jars, High Straight Form, Knob Top.

Cap., gallons ...	½	1	2	3	4
Inside, diam., in..	5	6	7	8½	9
Inside ht., in.....	9	11	15	15	18
Each **$2.50**		3.25	4.25	7.00	9.00

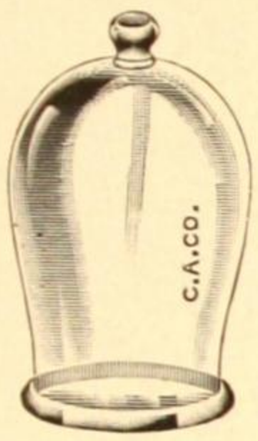
48R. Bell Jar, High Straight Form, Tubulated Top. Inside diameter 6½ inches, inside height 11 inches, capacity 1 gallon. Top opening takes No. 5 rubber stopper **$3.25**

49R. Bell Jars, High Straight Form, Open Top, with reground rim and top ground flat.

Capacity, gallons	½	1	2
Inside diameter, inches	5	6½	7
Inside height, inches	9	11	15
Diameter of opening, inches.	1	1¼	1½
Each **$2.40**		3.25	4.50

50R. Bell Jars, High Straight Form, Glass Stoppered.

Capacity, gallons	½	1	2
Inside diameter, inches....	5	6	7
Inside height, inches	9	11	15
Each **$2.60**		3.50	4.50



No. 51R.



No. 53R.



No. 65R.



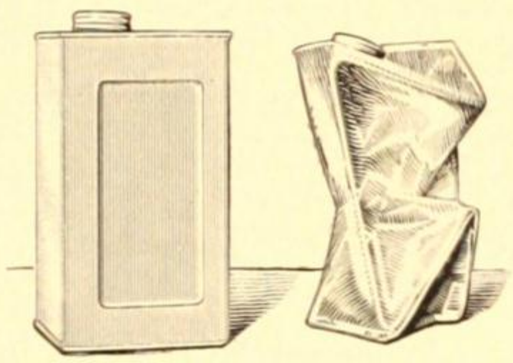
No. 70R
with No. 201R.



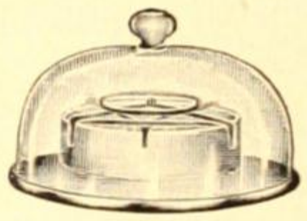
No. 70R
with No. 75R.



No. 114R.



No.124R.



No. 129R.

51R. Bell Jars, High Swelled Form, Knob Top, with reground rim.

Capacity, gallons	1	2
Inside base diameter, inches	6	7
Inside height, inches	10	12
Each	**$3.25**	**4.50**

53R. Bell Jar, Extra Tall Form. Fits over a full length barometer tube. Excellent for studying the effect of reduced pressure on the mercury column of barometers. Overall height, 86 cm. **$5.00**

65R. Bell Jars, Low Straight Form, Knob Top, with reground rim.

No.	A	B	C
Height, inside, inches	4	5	8
Diameter, inside, inches	6	8	10
Each	**$2.50**	**3.50**	**6.25**

70R. Bell Jar with Brass Cap. The cap is threaded to receive stopcock No. 189R or No. 201R. Can be evacuated by being placed on a separate ground-glass plate and connected by means of rubber tubing with any air pump. Also may be used on plate of any pump. With No. 75R Sliding Rod in place, various objects can be suspended and electrical connections made inside the jar. Without sliding rod or stopcock **$7.00**

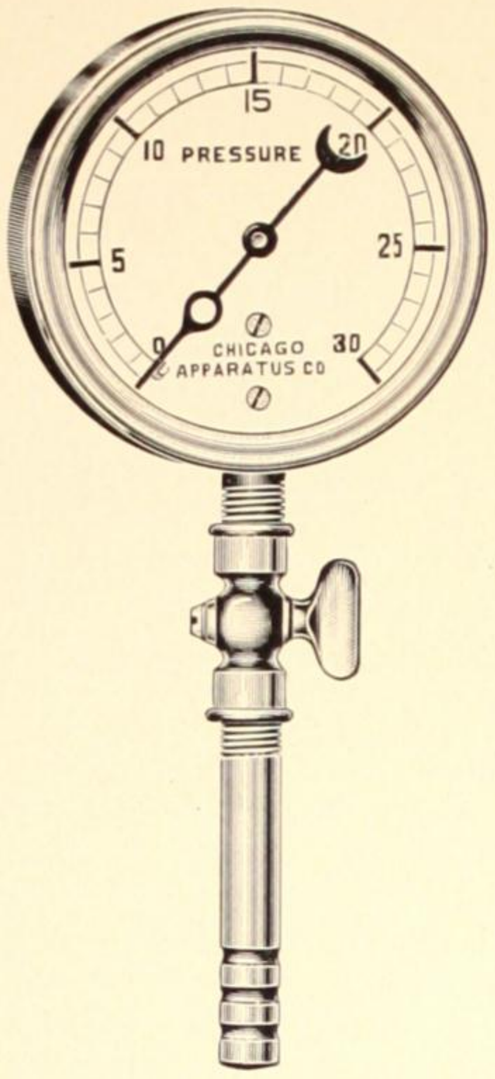
75R. Sliding Rod. Fits air-tight in brass cap of No. 70R. Provides means for hanging various objects and making electrical connections inside of jar. **$2.00**

114R. Bursting Cube. Of thin glass, about 7x7x7 cm. When placed under bell jar and air exhausted cube bursts with considerable force, illustrating the expansion of air when outside pressure is removed. **$0.35**

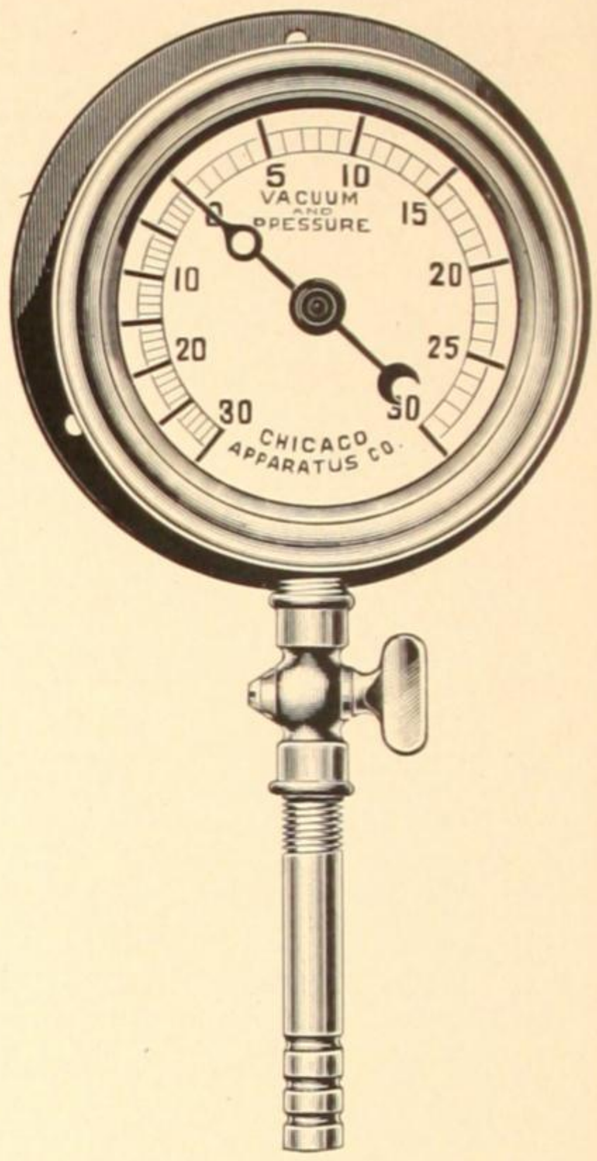
119R. Bursting Cube Guard. A cylinder of wire netting to be placed over No. 114R Bursting Cube to protect the bell jar. Diameter 12.5 cm., height 23 cm. **$1.25**

124R. Can, Taper Neck, with Rubber Stopper. Bright tin with screw cap. For showing the crushing effect of atmospheric pressure. Boiling a small quantity of water in the can drives out most of the air. If the can is then corked and plunged into cold water, the steam inside will condense and the can collapse, due to the enormous pressure of the outside air. **$0.50**

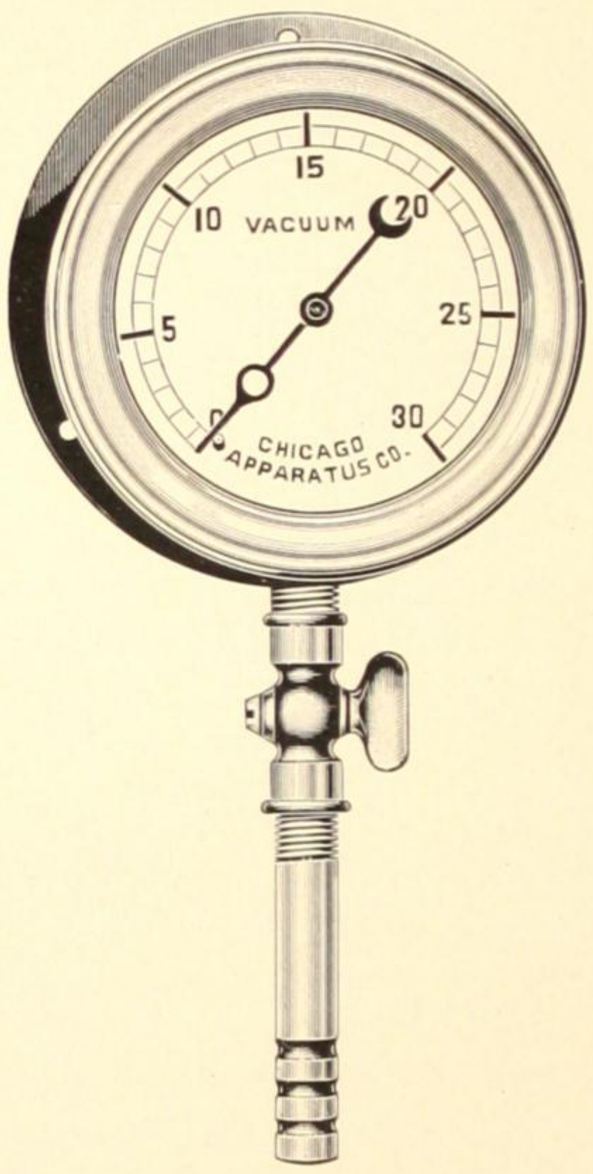
129R. Freezing Apparatus. For showing freezing by the rapid evaporation of ether. Consists of a bell jar 20 cm. in diameter and 12.5 cm. high, with 7.5 cm. crystallizing dish, triangle and watch glass **$2.75**



No. 130R.



No. 133R.



No. 132R.

130R. Gage, Pressure. 0 to 30 Lbs. Per Square Inch. Commercial type, improved single spring form, for air, steam, or water pressure. Iron case with nickel-plated trimming, 3½ inch dial. Provided with stop-cock and nipple for attaching hose.....**$3.50**

131R. Gage, Pressure. 0 to 100 Lbs. Per Square Inch. Otherwise same as No. 130R.....**$3.50**

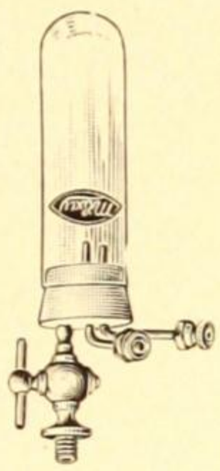
131Ra. Gage, Pressure, 0 to 100 Lbs. Per Square Inch. So-called standard or test gauge. Before shipment this gauge is carefully standardized against an open column of mercury and is therefore guaranteed to be correct. Made entirely of brass.....**$14.75**

132R. Gage, Vacuum. 0 to 30 Inches. Otherwise same as No. 130R **$3.50**

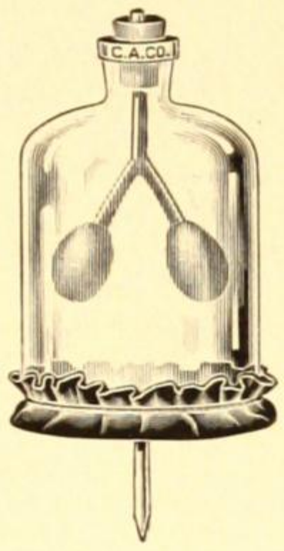
133R. Gage, Vacuum and Pressure Combined. 0 to 30 inches and 0 to 30 lbs. per square inch. Otherwise same as No. 130R.....**$5.00**



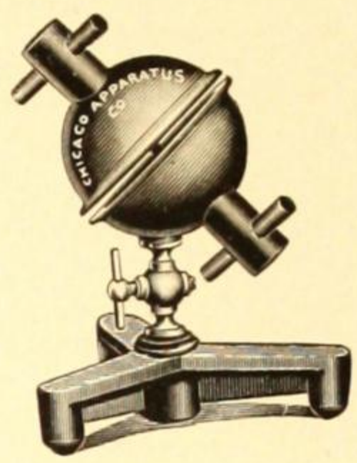
No. 134R.



No. 139R.



No. 142R.



No. 149R.

134R. **Guinea and Feather Tube.** May also be used as Fountain in Vacuo and as an Aurora Tube. Heavy glass tube 110 cm. long by 4.5 cm. diameter, with brass caps, one being removable so that the tube may be easily cleaned. Provided with stopcock to fit air pumps with 7/16-16 opening, and tripod base for protection when not in use. Complete with metal disc and feather. Three different uses for this tube are: (a) Guinea and Feather Tube. Remove from tripod, attach to air pump, open cock, exhaust tube, close cock and disconnect tube from pump. Rapidly invert tube, notice both metal disc and feather drop together. Open cock, air fills tube, notice how metal disc reaches bottom first. (b) Fountain in Vacuo. Exhaust tube as before, dip stopcock under water. Open cock, water will enter the tube with a rush, stream reaching top of tube. (c) Aurora Tube. Exhaust tube, connect stopcock and metal knob to terminals of an electric machine or an induction coil. The spark generated produces beautiful effects in tube. These are best observed in darkened room **$10.00**

137R. **Ground Glass Plate, 150x150 cm.** For use in connection with No. 44R, No. 49R and other open top bell jars **$0.20**

139R. **Incandescent Lamp. Milvay.** Demonstration form. Glass globe, 4x12.5 cm., fitted with rubber stopper provided with two electrodes and a stopcock. The electrodes are fitted with binding posts at their outer end with mercury cups at their inner end, into which No. 140R Carbon Filaments may be inserted. The outer end of the stopcock is threaded 7/16-16 for attachment to any of our air pump plates. Without carbon filaments **$4.25**

140R. **Carbon Filaments.** To fit No. 139R, for 110 volts. **Per dozen** **$0.50**

142R. **Lung Demonstration Apparatus.** For demonstrating the manner in which lungs inhale and exhale air. The lungs are represented by two rubber balloons attached to a Y piece held in a rubber stopper inserted in the neck of a bell jar. The diaphragm consists of thin sheet rubber stretched over and tied to the flange. When the diaphragm is pulled out air is drawn into the balloons (lungs); and when pushed in, the air is expelled. In addition to the expansion and contraction of the balloons, this in-and-out movement of air may be visualized by bringing a candle flame near the open end of the Y piece. Complete as illustrated..... **$4.50**

144R. **Leather Washers.** For use with stopcocks, guard plugs, etc. Outside diameter 7/8 inch, inside diameter 7/16 inch. **Per dozen**..... **$0.15**

145R. **Leather Washers.** To fit piston of No. 9R Air Pump. For replacement. **Per set of two**.... **$0.25**

146R. **Leather Washers.** To fit piston of No. 14R Air Pump. For Replacement. **Per set of two**.. **$0.35**

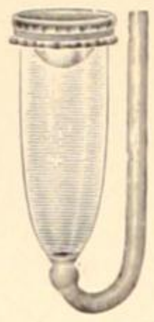
147R. **Leather Washers.** To fit piston of No. 24R Air Pump. For replacement. **Per set of two**.... **$0.50**

148R. **Leather Washers.** To fit piston of No. 29R Air Pump. For replacement. **Per set of two**.... **$0.35**

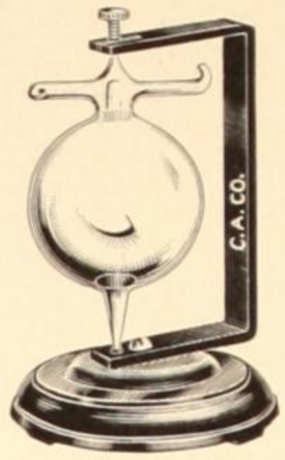
149R. **Magdeburg Hemispheres.** Pair of accurately-fitting iron hemispheres 12 cm. in diameter. When fitted together and air inside exhausted, they cannot be pulled apart; but placed under a bell jar and the air exhausted they will fall apart of their own weight. Excellent for demonstrating atmospheric pressure. Stopcock fits any air pump with 7/16-16 opening. Mounted on tripod base for protection when not in use **$6.00**



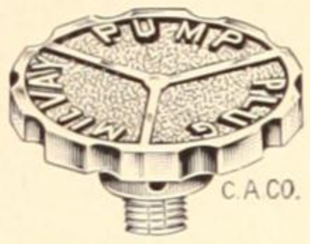
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No. 164R.



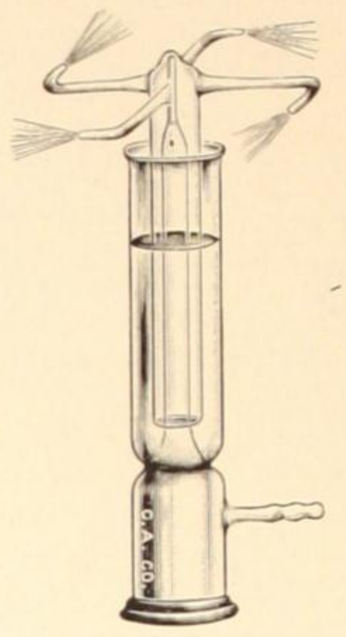
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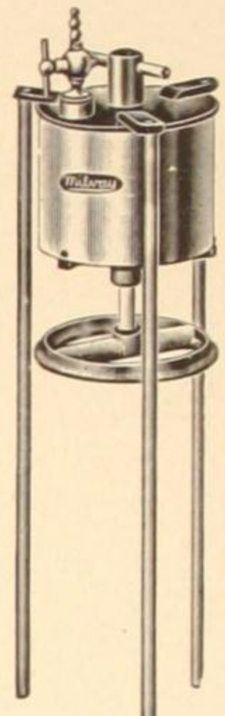
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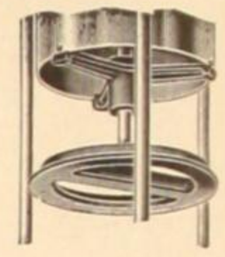
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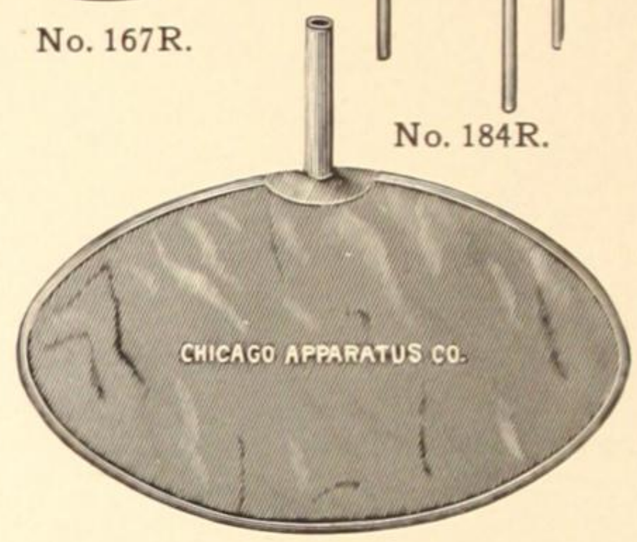
No. 167R.



No. 184R.



(Cut Showing Guide for Piston).



No. 177R.

154R. Mercury Shower. For illustrating the porosity of wood. Consists of a wood funnel, the bowl of which is heavily varnished to render it impervious to mercury. The stem, unlike an ordinary funnel, has no hole through it, but consists merely of a solid unfinished wooden rod. When mercury is placed in the wood funnel, the funnel placed on a No. 44R Bladder Glass, as illustrated, and the air exhausted from the bladder glass, the mercury quickly passes through the pores in the wood stem and drops into the dish below. Without bladder glass or dish **$1.00**

156R. Pump Oil, Vacuum. A specially prepared oil for use in No. 29R Geryk-Type and other air pumps. In metal cans.

No.	A	B	C
Size	1 pt.	1 qt.	1 gal.
Per can	**$0.45**	.65	2.00

159R. Parchment Paper. Vegetable, in sheets 18x24 inches.
Per sheet **$0.05**
Per quire ..... .50

160R. Parchment Paper. Genuine animal product, in sheets 17x22 inches. **Per sheet** **$2.50**

164R. Pressure of Air Apparatus. For illustrating air pressure. Consists of a glass vessel about 17 cm. long, and 7 cm. in diameter, one end of which is provided with a rubber diaphragm, the other end with a rubber tube. A slight suction will force the diaphragm inward, as illustrated; a strong suction will burst it **$1.00**

165R. Pump Guard Plug, New Milvay Design. Threaded 7/16-16 to fit any standard pump plate. Prevents glass, mercury and other undesirable substances from entering the pump while allowing free passage of the air. Head, 50 mm. in diameter, is large enough to form a good support for bursting cubes, mercury dishes, etc. The heads of the old style plugs are too small for this purpose, hence they cannot be used in the very experiments in which their protection is most needed. Made of brass, nickel-plated **$1.00**

166R. Reaction Wheel. For illustrating Newton's Third Law of Motion. Glass globe rotates rapidly when a bell glass under which it has been placed is being exhausted. Works well under a one gallon bell jar. On metal stand about 17.5 cm. high.. **$2.25**

167R. Reaction Wheel, Gas Flame Type. When this device is partially filled with water as indicated and then connected to an air pressure supply, the upper member with its four attached bent arms will revolve at high speed. If gas is used instead of air and the escaping gas ignited, the resulting effect is extremely spectacular. Entirely of glass.... **$2.50**

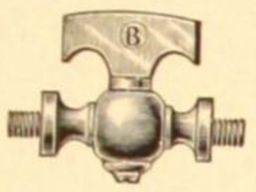
169R. Rubber Balloon, with Valve. Valve opens and closes with a single twist of neck. Eliminates tying with string. Pure gum, diameter deflated about 5 cm. For use under bell jar to show elastic force of air **$0.10**

174R. Rubber Dam. Thin pure gum sheet rubber. **Per square foot** **$0.25**

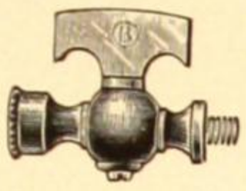
175R. Rubber Dam. Thin pure gum sheet rubber, 12 inches wide. **Per linear yard** **$0.60**

177R. Rubber Football Bladder. Standard size... **1.25**

184R. Seven-in-One Apparatus, Milvay. (Spirometer.) New form with reversible legs so that the spirometer may be supported with the platform at the top or at the bottom. The convenience of this construction will be especially appreciated when using the spirometer as a Hydraulic Press, Hydrostatic Bellows, or Pneumatic Lift. The cylinder is of heavy seamless brass tubing, 12.5 cm. in diameter by 9.5 cm. long, provided with an air-tight and water-tight piston. A recent improvement consists of a guide for the piston—it insures smooth piston action and makes jamming impossible. Both ends are provided with handles so that the spirometer may be conveniently used as Magdeburg Hemisphere. One handle is so designed that it may also be used as a platform for supporting the weights used in Hydraulic Press and Hydrostatic Bellows work. Complete with stopcock, reversible legs 50 cm. long, rubber tube and metal water reservoir..... **$16.00**



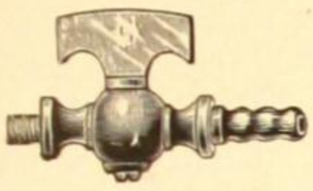
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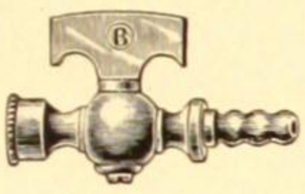
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No. 204R.



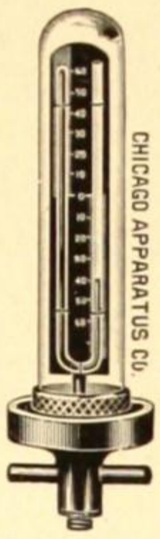
No. 194R.



No. 201R.



No. 209R.



No. 214R.



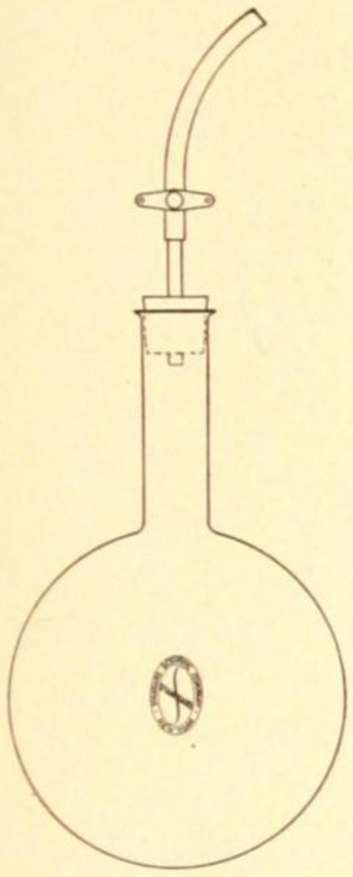
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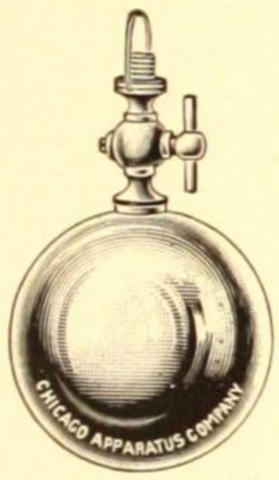
No. 221R.



No. 224R.



No. 232R.



No. 234R.



No. 229R.

Stopcocks and Nipples

Made of brass, polished and lacquered, ground plugs with "T" handles, threaded 7/16-16, which is the standard thread used on all our air pump plate and air pump accessories.

189R. **Stopcock,** double male screw.....**$1.00**

194R. **Stopcock,** one end for $\frac{5}{16}$ in. bore rubber tubing, the other with male screw.....**$1.00**

199R. **Stopcock,** both ends for $\frac{5}{16}$ in. bore rubber tubing **$1.00**

200R. **Stopcock,** one male and one female screw. 1.25

201R. **Stopcock,** one end for $\frac{5}{16}$ in. bore rubber tubing, the other with female screw.....**$1.50**

202R. **Stopcock,** both ends with female screws.. 1.65

204R. **Nipple, Brass,** female screw..... .35

209R. **Nipple, Brass,** male screw..... .35

165W. **Stopcock Grease, Ernest's.** Does not dry out or harden, makes stopcocks leak-proof and prevents plugs from sticking. **Per tube**.....**$0.35**

214R. **Vacuum Gauge or Manometer.** For use on air pumps and air pump plates to indicate directly all pressures under 140 millimeters of mercury. This new model is provided with a groove for oil-sealing the joint between the dome and base, thus making this gauge absolutely leak-proof. Fits our Nos. 24R, 29R, 4416R, 4417R, 4419R and all other pumps having standard $\frac{7}{16}$ inch openings. The mercury-filled manometer tube is mounted on a nickel-silver scale graduated for 14 cm. in millimeters and is mounted under a removable glass dome.....**$10.00**

219R. **Vacuum Gauge or Manometer.** For use under bell jars to indicate directly all pressures under 150 millimeters of mercury. The mercury-filled manometer is mounted on a wooden scale graduated for 15 cm. in millimeters. On metal base.....**$2.50**

221R. **Vacuum Gauge.** McLeod High Vacua Type. A practical and scientifically accurate instrument for measuring vacuums from 200 microns to half a micron (.2 mm. to .0005 mm.). Each gauge is calibrated and the scale marked directly in microns, making mathematical calculations unnecessary. All parts are completely protected by the wood frame. Height, about 60 inches. Mercury required, 7 pounds **$60.00**

224R. **Vacuum Wax.** For coating the flanges of bell jars, Magdeburg Hemispheres, etc., to insure air-tight junctions and connections. Will not harden, can be easily removed, does not injure pump plate or apparatus. Better than tallow, vaseline, or heavy oil. **Per 4 oz. jar** **$0.25**

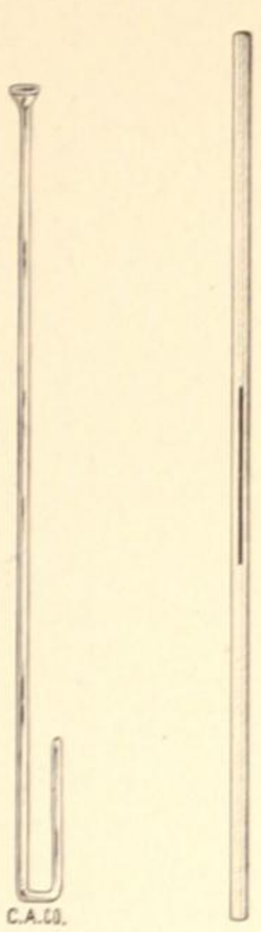
229R. **Water Hammer.** A glass vacuum tube with bulb, 25 cm. long, partially filled with water. When inverted the water falls against the bottom with a solid click.....**$1.20**

232R. **Weight of Air Flask.** Round bottom, 500 cc. capacity, rubber and glass connections. Complete with pinchcock **$1.00**

234R. **Weight of Air Globe.** Hollow brass globe, polished and gold lacquered, 10 cm. in diameter, with stopcock to fit air pump with 7/16-16 opening. Provided with a removable hook **$4.50**

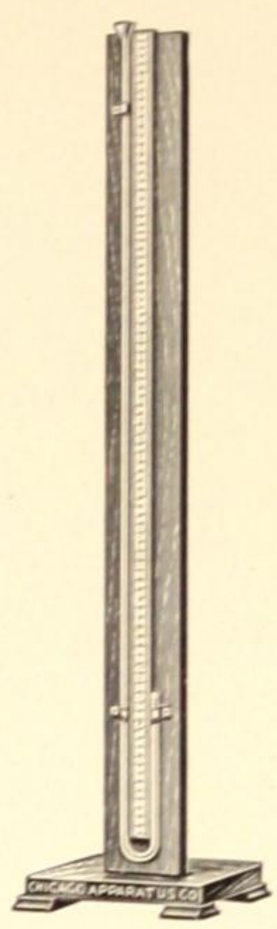
Weight of Air Globes of Glass listed under Nos. 192B, 192Ba and 193B in Balances and Weights Section.

BOYLE'S LAW APPARATUS AND AIR THERMOMETERS

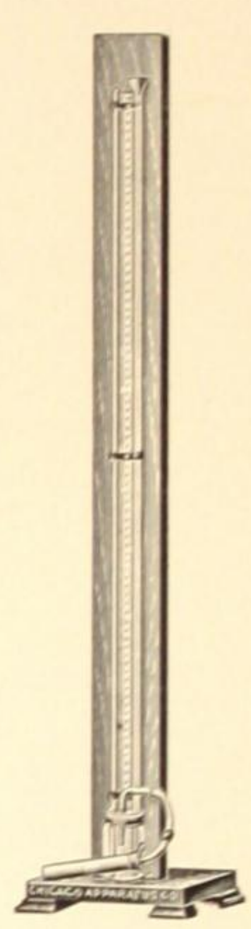


No. 235R.

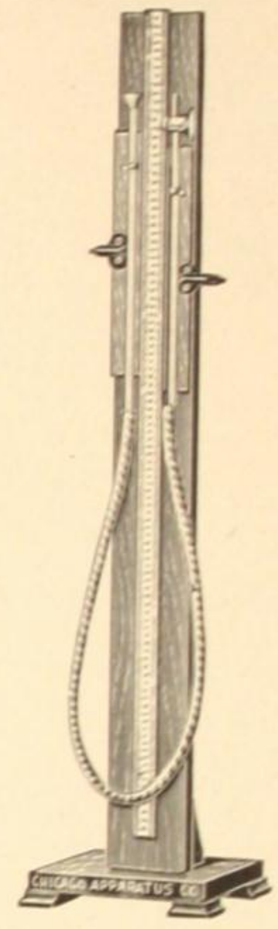
No. 236R.



No. 238R.



No. 239R.



No. 240R.

235R. Boyle's Law Tube. J-shaped, glass, the open arm 100 cm. long and provided with funnel top, the closed arm 20 cm. long. The tube is so designed that standard meter stick may be placed between its arms. For use in verifying Boyle's Law—volume of a gas, temperature remaining constant, varies inversely as the pressure to which it is subjected. . **$0.85**

236R. Boyle's Law Tube. As used in Millikan, Gale and Bishop's Course. Glass tube, 110 cm. long, 6 mm. outside diameter, 1 mm. bore, with mercury index **$1.25**

237R. Boyle's Law Tube. Same as No. 236R, but without mercury index **$0.70**

238R. Boyle's Law Apparatus. Glass tube No. 235R mounted on a mahoganized hardwood support, 105 cm. high, with millimeter scale one meter long. **$5.00**

239R. Boyle's Law Apparatus. Cistern form as used at the Northwestern University and the University of Chicago. In this form the air contained in the closed tube may be subjected to any pressure from ½ to 2 atmospheres. Pressure is applied by means of a small bicycle pump to the surface of mercury contained in a small glass cistern. This forces the mercury up into two long narrow glass tubes, one closed, the other open, and which dip at their lower end into the mercury in the cistern. By noting the changes in the volume of the air in the closed tube, and the relative height of the mercury in both tubes for different pressures, a curve may be plotted which will show that the relation between pressure and volume conforms to Boyle's Law. Mounted on mahoganized hardwood support 120 cm. high. In our improved design the cover of the cistern is securely clamped down to overcome the trouble at high pressure experienced with older forms. Complete with millimeter scale one meter long, air pump and full directions, but without mercury. . **$7.50**

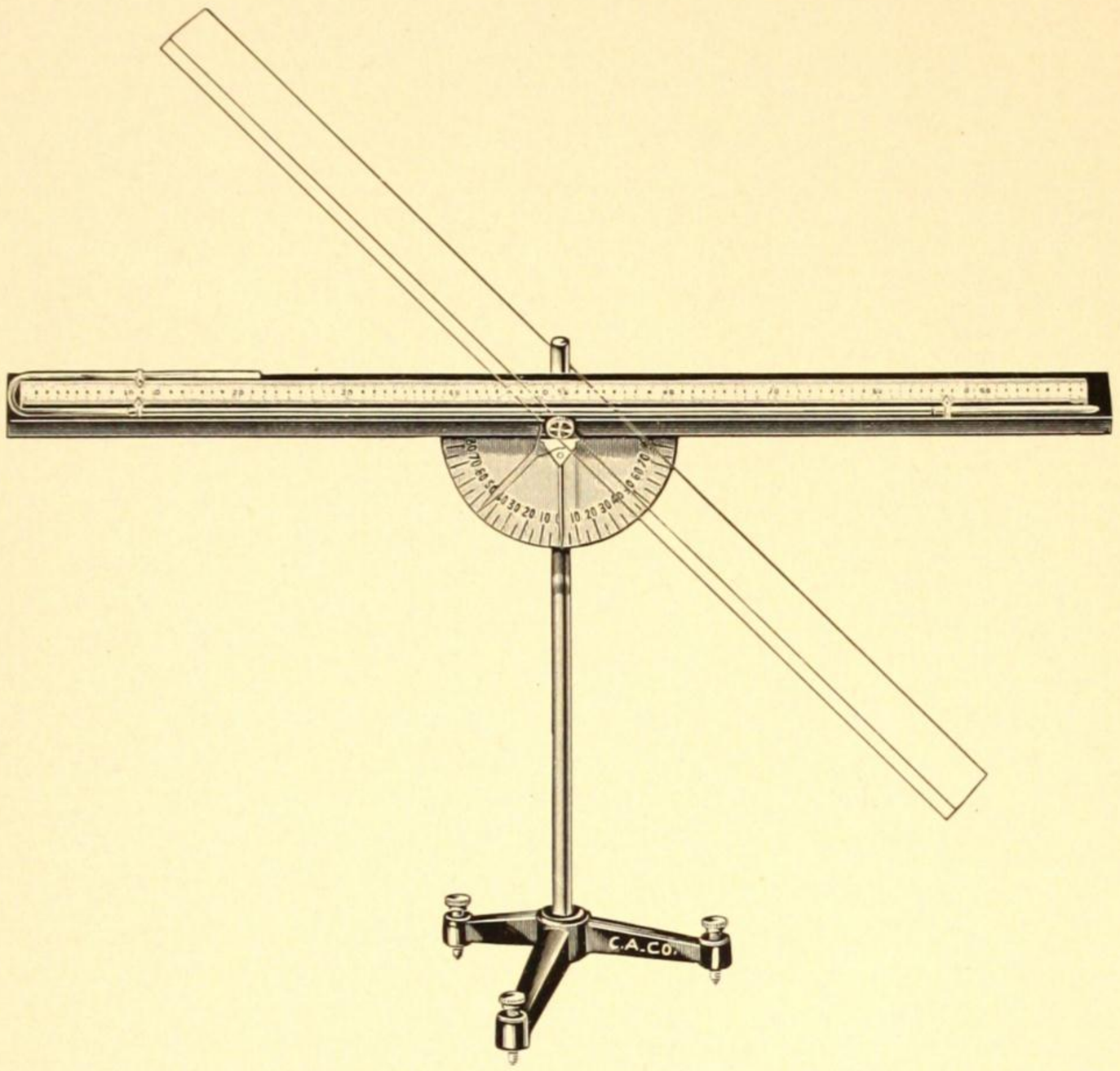
240R. Boyle's Law Apparatus. Adjustable Form. Consists of an open funnel tube and a tube closed by a stopcock, each mounted upon a slide which can be clamped at any height on the support. The stopcock provides an easy means of allowing the air to escape from the closed tube when introducing the mercury. It is also useful for instantly equalizing the pressure in both arms. Both tubes are connected with a heavy rubber tube, 120 cm. long, with woven silk covering to prevent it from bulging. Mounted on a mahoganized hardwood support, 105 cm. high, with millimeter scale one meter long..... **$10.00**

241R. Funnel Tube. Glass, as used on No. 240R, about 30 cm. long..... **$0.40**

242R. Closed Tube. Glass, with stopcock, as used on No. 240R, about 40 cm. long..... **$2.00**

243R. Rubber Tube. With woven silk covering, 120 cm. long, as used on No. 240R..... **$1.00**

Harmon's Boyle's Law Apparatus



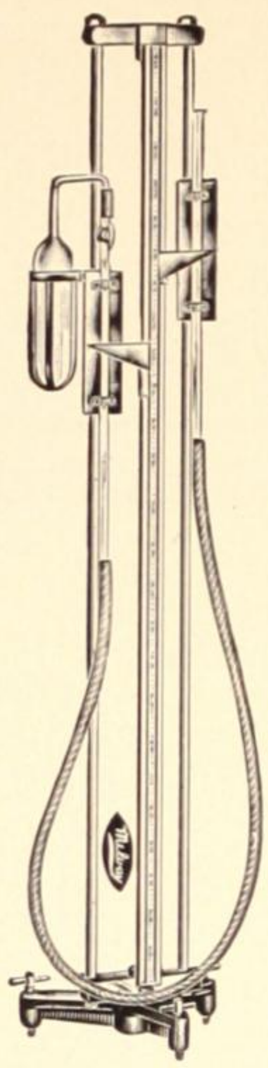
No. 244R.

244R. Boyle's Law Apparatus, Harmon's. After design by Prof. Herbert W. Harmon, Dept. of Physics, Grove City College, Grove City, Pa. This form has been in use in the above mentioned institution for eighteen years and during that time has been operated by over one thousand students without accident, indicating that it is practically fool proof. Careful students get results uniformly within an error of one percent. The ease of operation enables the student to obtain a large number of readings to graph in an ordinary laboratory period.

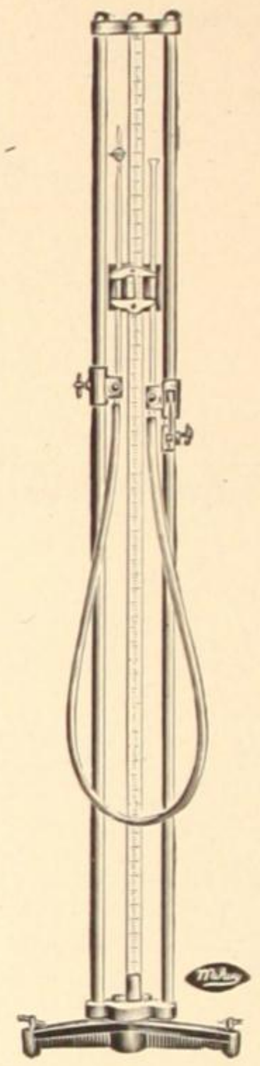
In use the meter stick is adjusted until both ends are at the same height above a level table top. The protractor is then adjusted until it reads zero. The length of the air column—the distance between the mercury and sealed end of the tube—is noted. Likewise the length of the mercury column and the distance from the table up to each end of the mercury column are noted. The tube is then tilted successively, with the open end up, to 10, 20, 30, etc. degree positions until the tube is vertical, and the same data as before noted for each trial. In the foregoing cases the pressure on the enclosed air column is the atmospheric pressure plus the vertical component of the mercury column.

For pressures upon the enclosed air column of less than an atmosphere the open end is tilted down, in which case the pressure is that of the atmosphere minus the vertical component of the mercury column. From the data secured a curve of volumes vs. pressures is plotted for both increasing and decreasing pressures. In both cases this should result in a smooth continuous curve.

The apparatus consists of a J-shaped tube on a tilting wooden back with a meter scale graduated in millimeters. This tube contains a mercury column approximately 74 cm. long and an enclosed air column about 15 cm. long. A pointer attached to the center of the tube mounting indicates the angle of tilt on a large protractor graduated in 5 degree divisions. The apparatus is mounted on a suitable tripod support. Complete as illustrated and with full directions **$10.00**



No. 245R.



No. 247R.

245R. Boyle's Law Apparatus and Air Thermometer. Milvay. Consists of an open funnel-end tube and a tube closed by glass stopcock, mounted on holders of highly polished and lacquered metal. These holders are provided with rapid-action clamps so that they may be conveniently clamped at any point along the scale. The two tubes are connected by a heavy rubber tube, with woven silk covering to prevent bulging. The support consists of two metal uprights, with a 100 cm. meter stick between them, mounted on a tripod base. The meter stick is provided with two sliding index pointers which extend in front of the tubes on either side. These pointers, together with the polished surface of the tube holders, enable the height of the mercury columns to be determined without error or parallax.

When using the apparatus as an air thermometer, the air thermometer bulb, which is held in a suitable support, is connected to the end of the stopcock tube, as shown in the illustration.....**$25.00**

247R. Boyle's Law Apparatus. Milvay. Precision Form. Support consists of two round metal rods with a square metal rod between them, mounted on a tripod base provided with leveling screws. A square rod is graduated in millimeters for 130 cm. of its length and is provided with a sliding mirror index for reading the height of the mercury without parallax. This index is provided with verniers reading to 1/10 mm. The closed tube is graduated and is provided with a stopcock. The open tube terminates at its upper end in a small funnel. Both tubes are connected at their lower ends by a rubber tube, silk covered to prevent bulging. Both tubes are mounted so that they can be conveniently clamped at any desired height on the round support rods. A slow-motion screw provides for fine adjustment of the height of the tube on the right hand side. The tube with stopcock may be removed and No. 249R Air Thermometer Attachment substituted. The tripod is finished in black japan, the other metal parts in polished nickel-plate **$60.00**

248R. Air Thermometer. Milvay. Same as No. 247R but with No. 249R Air Thermometer Attachment substituted for the stopcock tube.....**$70.00**

249R. Air Thermometer Attachment. Milvay. For No. 247R. With three-way stopcock, steel coupling and platinum point for reading mercury meniscus. The bulb is provided with a stopcock at the lower end, to facilitate the filling of the bulb with perfectly dry air. Capacity of bulb about 185 cc.....**$10.00**

Extra Parts for No. 247R Boyle's Law Apparatus

250R. Funnel Tube. Glass, about 30 cm. long, with steel coupling **$1.50**

251R. Rubber Tube. A heavy rubber tube 180 cm. long; silk covered to prevent bulging, and provided with special metal ends to fit the coupling of No. 247R.....**$2.00**

252R. Stopcock Tube. Glass, about 40 cm. long, with steel coupling. Capacity, 6 cc., graduated in tenths **$5.00**



Quick Deliveries

THE arrangement of the stock in our plant is as simple, orderly and systematic as a card index. There is a place for everything and everything is in its place. Then, too, there is plenty of room, plenty of daylight, plenty of ventilation and plenty of stock. These things insure the same quick, accurate delivery service which the Chicago Apparatus Company has given to laboratories for over two decades, and for which this company has become so well known.

Apparatus for Mechanics of Liquids

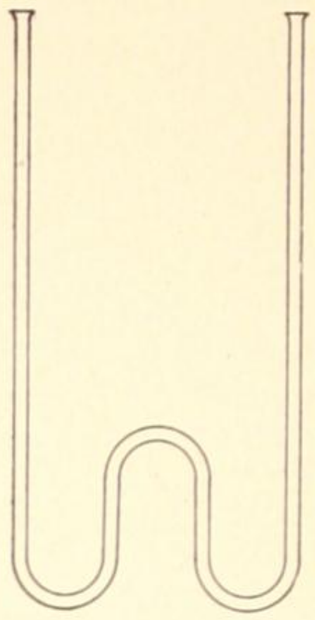
Section R



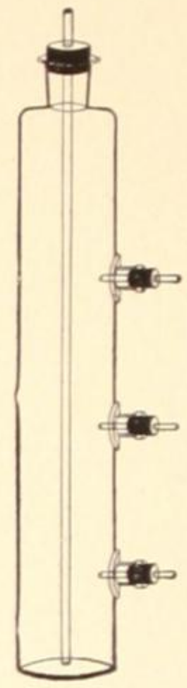
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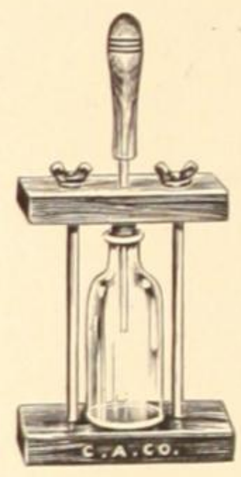
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No. 256R.



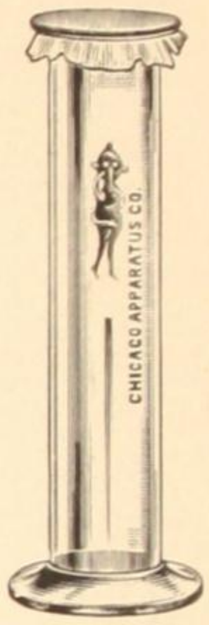
No. 257R.



No. 259R.



No. 264R.



No. 265R.

254R. Archimedes Principle. For showing that the loss in weight of a submerged body is equal to that of its own volume. Consists of a nickeled-brass cylinder (with hook) which exactly fills a nickeled brass cup (22x38 mm.) with handle **$1.60**

255R. Balance, Flotation, Dull's. A compression balance for measuring the buoyant force (about 175 grams) of a wooden block like our No. 279R, as outlined in Dull's "Laboratory Exercises in Physics." Exp. 8, (1929). Since the buoyant force of a floating block cannot cause spring compression, or pointer movement, until the buoyant or upward force exceeds the weight or downward gravitational pull on the sliding rod, the weight of the latter is adjusted to correspond exactly to the lowest graduation on the balance, namely 50 grams. In this way the "weight-of-sliding" rod error—about 50 grams—unavoidable in flotation balances graduated down to zero, is eliminated. Thus, every indication on this new balance, within its range, 50 to 250 grams, is a true measure of the upward force against its lower four points. Further, the longer scale and finer divisions—5 grams—permit closer readings. Heavy brass, nickel-plated cylindrical body, with aluminum sliding rod. Overall length, 24 cm.....**$4.75**

256R. Balancing Column Tube. Millikan, Gale and Bishop form. Double U-tube of 6 mm. glass tubing, overall length about 50 cm.....**$1.00**

257R. Bottle, Mariotte's. Has one opening at top and three at side, into which are fitted rubber stoppers and glass tubes of equal bore. Excellent for demonstrating liquid pressure at different depths. Capacity one gallon **$5.00**

258R. Pressure Tank with Three Holes. For demonstrating liquid pressure at different depths. Galvanized tank 12.5x12.5 cm. by 30 cm. high with open top and three small holes in one side 2.5, 14 and 28 cm. from the bottom. Any hole may be closed or shut off by placing a small piece of sheet rubber over the inside opening **$1.75**

225C. Bottles, Specific Gravity. Accurately adjusted at 20 degrees C., flint glass with perforated stopper.

Cat. No.	225C	226C	227C	228C
Capacity, cc.	10	25	50	100
Each	**$0.80**	**1.00**	**1.25**	**1.60**

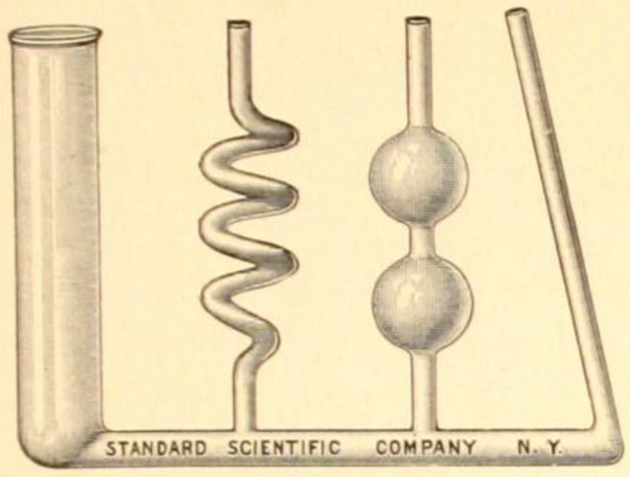
230C. Bottles, Specific Gravity. Unadjusted, for self-adjustment, flint glass, with perforated stopper.

Cat. No.	230C	231C	232C	233C
Capacity, cc.	10	25	50	100
Each	**$0.45**	**.50**	**.60**	**.75**

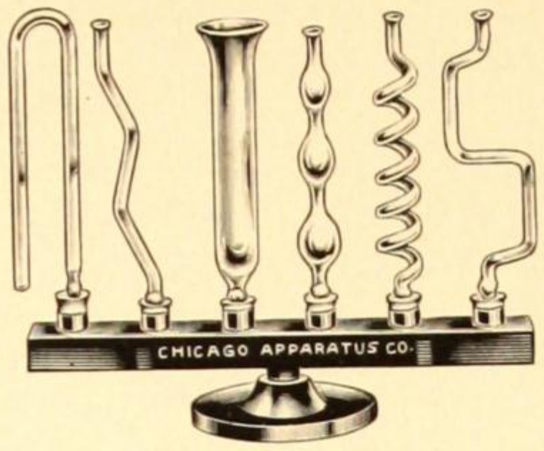
259R. Bursting Bottle Apparatus. For illustrating the incompressibility of liquids. Consists of frame bottle and plunger. Bottle, filled with water, is broken when plunger is forced down into it. Complete with three 6 oz. bottles. (For extra bottles see No. 125C—6 oz.) **$3.25**

264R. Cartesian Diver. Illustrates principle of Archimedes, compressibility of gases, and transmission of liquid pressure. Consists of a hollow glass figure about 4 cm. long, which just barely floats in water and having a small opening at its lower end. To be placed in water contained in a jar provided with rubber diaphragm. Pressure on the diaphragm causes the diver to sink; releasing the pressure causes the diver to rise. Diver only.....**$0.30**

265R. Cartesian Diver. No. 264R complete with 8x1½ inch glass jar and rubber diaphragm....**$1.00**



Nos. 269R-270R.



No. 271R.



No. 272R.



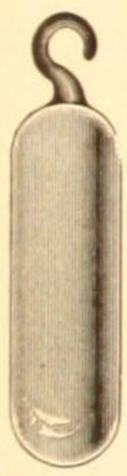
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No. 284R.



No. 289R.



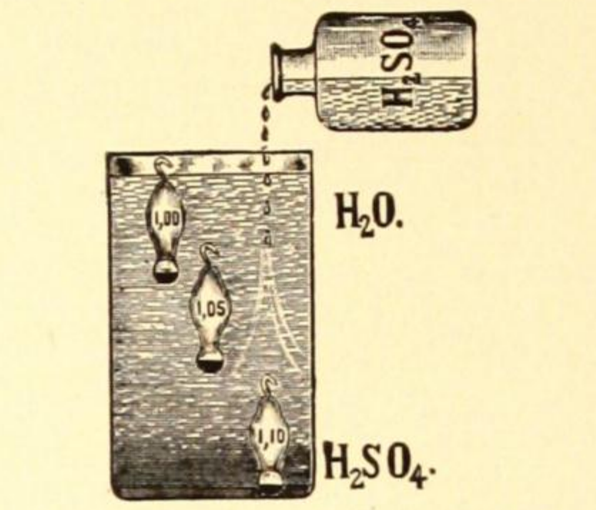
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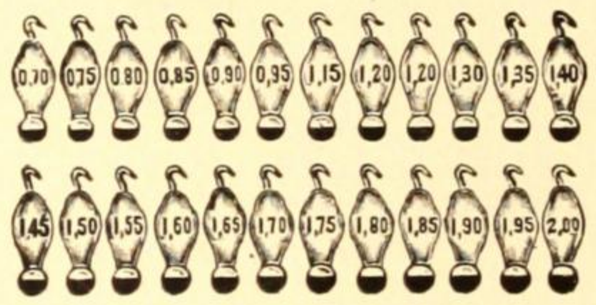


Nos. 304R-308R.



No. 314R.





No. 297R.

269R. **Communicating Vessels.** For illustrating that a liquid rises to the same height in all the vessels of a communicating system. Made entirely of glass. Height, about 15 cm. **$1.00**

270R. **Communicating Vessels.** Same as No. 269R, but mounted on a neat metal stand..... **$2.25**

271R. **Communicating Vessels. (Equilibrium Tubes.)** Set of six glass tubes of different shape and size on brass base 30 cm. long. Height about 25 cm.. **$6.00**

272R. **Density Ball.** For demonstrating the effect of temperature on the density of a liquid. A metal ball, 3 inches in diameter, properly adjusted to float in cold water and to sink in warm water. Without beaker **$3.00**

274R. **Density Block, Aluminum.** About 4x4x4 cm., hole in rib for attaching thread..... **$0.60**

279R. **Density Block, Wood.** Waterproofed, not loaded. Size 7.5x7.5x3.8 cm. **$0.20**

284R. **Density Block, Wood.** Waterproofed and loaded internally so as to sink in water. Size 7x4.5x4.5 cm. **$0.30**

289R. **Density Bob.** Glass, 13mm. diameter, 5 cm. long, with hook. For use in determining the specific gravity of liquids. May be used with Jolly Balance **$0.50**

297R. **Density Plummets.** Set of 27, weighted with mercury and carefully adjusted, ranging from 0.700 to 2.000 in steps of 0.05. By means of these plummets a most striking demonstration of the different densities of liquids may be made. **Per set**..... **$14.75**

299R. **Density Cylinder, Aluminum.** 82 mm. long, 25 mm. diameter, weight about 130 grams, with hook **$0.50**

304R. **Density Cylinder, Aluminum.** 13 mm. diameter, 40 mm. long **$0.20**

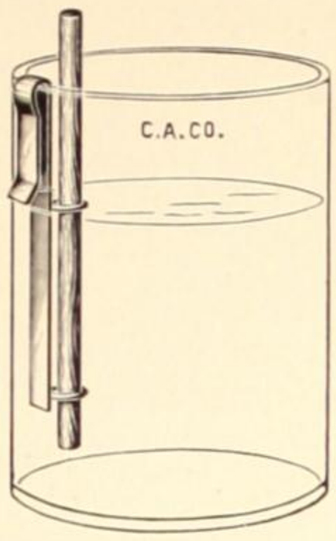
305R. **Density Cylinder, Brass.** 13 mm. diameter, 40 mm. long **$0.20**

306R. **Density Cylinder, Copper.** 13 mm. diameter, 40 mm. long **$0.20**

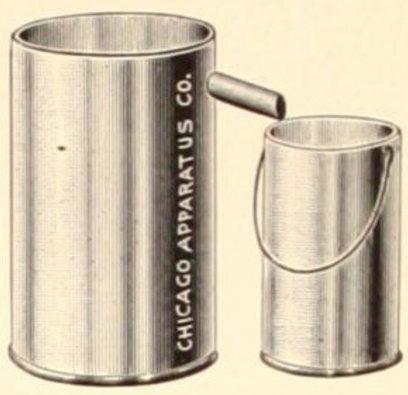
307R. **Density Cylinder, Hard Rubber.** 13 mm. diameter, 40 mm. long **$0.20**

308R. **Density Cylinder, Steel.** 13 mm. diameter, 40 mm. long **$0.20**

314R. **Density Cylinder, Wood.** Waterproofed and loaded internally to float nearly submerged in water. Length 8 cm., diameter 4.5 cm. **$0.35**



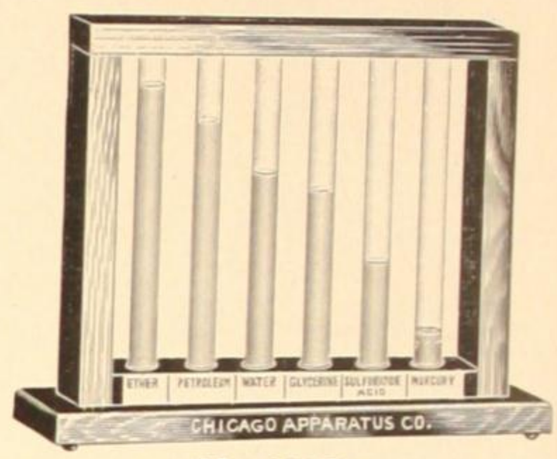
Nos. 319R-324R.



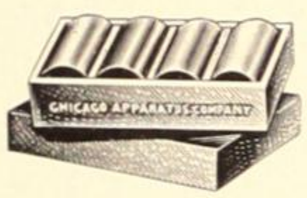
No. 329R. No. 331R.



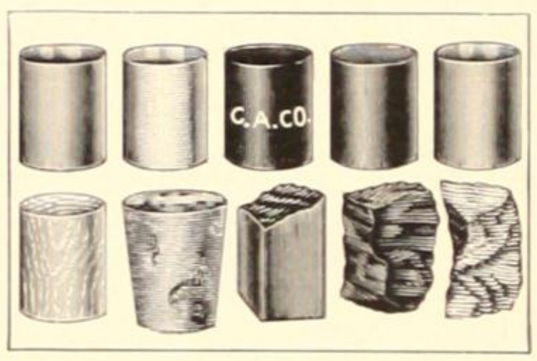
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No. 334Ra.



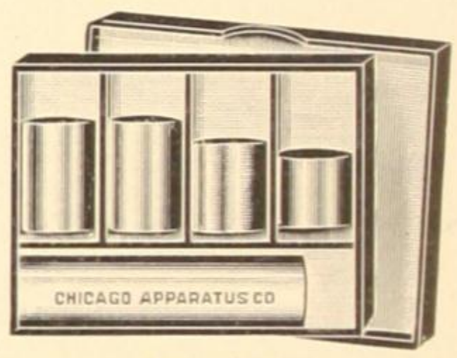
No. 335R.



No. 336R.



No. 337R.



No. 338R.

319R. Density Cylinder, Wood. Waterproofed, length 20 cm., diameter 1 cm. **$0.10**

324R. Density Cylinder Holder, Brass. Clamps on the edge of a battery jar and is provided with two metal rings for keeping No. 319R Density Cylinder upright in water **$0.35**

329R. Density Overflow Can, Brass. Nickel-plated, 14 cm. high, 7 mm. diameter, capacity about 600 cc. **$0.70**

331R. Density Catch Bucket. Brass, nickel-plated, capacity about 175 cc., with wire handle..... **$0.60**

334R. Density Sinker, Lead. Weight about 175 grams, with hook **$0.25**

256H. Density Sinker, Lead. Weight about 700 grams, with hook **$0.60**

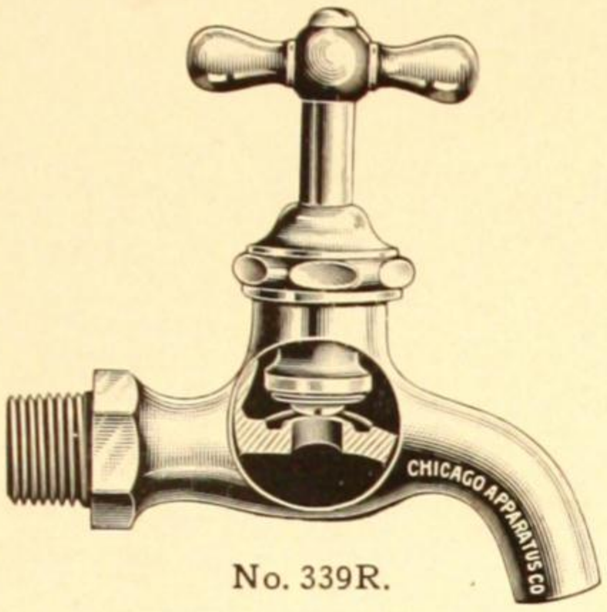
334Ra. Density Specimens of Liquids, in Frame. Specimens of equal weights of six different liquids in uniform glass tubes. The heights of the liquids are inversely proportional to their specific gravities. The set includes Ether, Petroleum, Water, Glycerine, Sulphuric Acid and Mercury. In neatly finished wooden frame **$5.50**

335R. Density Specimens. Set of Four. One each aluminum, brass, copper and steel cylinders, 13 mm. diam. x 40 mm. long, in pasteboard box..... **$0.75**

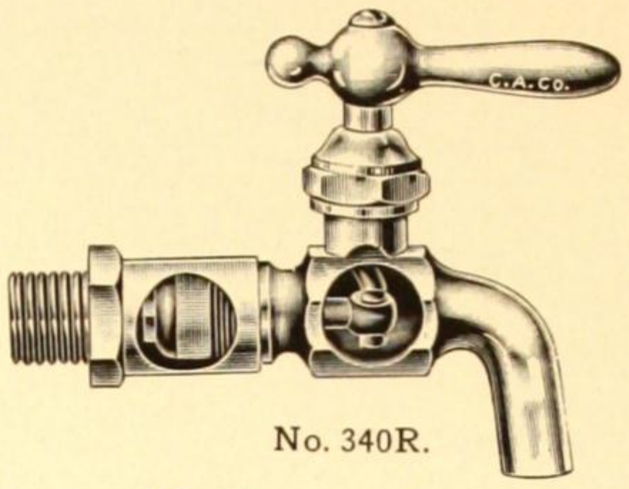
336R. Density Specimens. Set of Ten. For student use in specific gravity experiments. Ten different specimens, about 5 cc. in volume, enclosed in pasteboard box **$0.50**

337R. Density Specimens of Wood Extremes, Milvay. Both weigh alike, yet one is eight times bulkier than the other, so great is the difference in density. Valuable in lecture work because of their large size—7.5x7.5x35 cm. and 7.5x7.5x4.3 cm. Placed on the pans of a trip scale they balance one another. Placed in a trough of water one sinks to a depth of 99%, the other to but 12%, indicating densities of 0.99 and 0.12. The larger and lighter specimen is made of Balsawood—the lightest wood known. It is 50% lighter than corkwood. Because of its great buoyancy it is used for building rafts, life preservers, aeroplane cabins, etc. The smaller and heavier specimen is of laurel wood, one of the densest woods known. **Per pair** **$2.25**

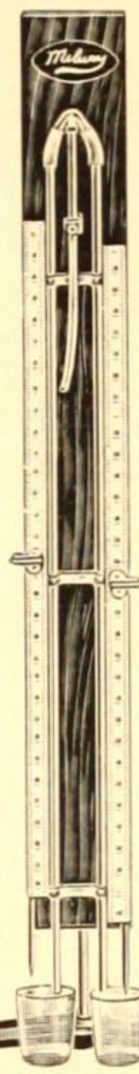
338R. Density Specimens of Metal, in box. Specimens of five different metals in cylinder form and of equal weight—about 70 grams—and equal diameter—about 19 mm. The heights of the cylinders are inversely proportional to their specific gravities. Set includes one each of lead, copper, tin, zinc, and aluminum. In compartment box **$2.50**



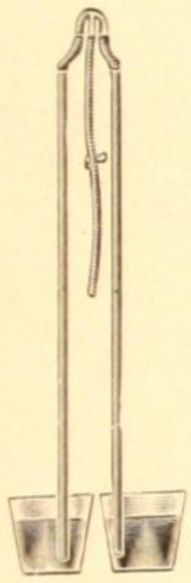
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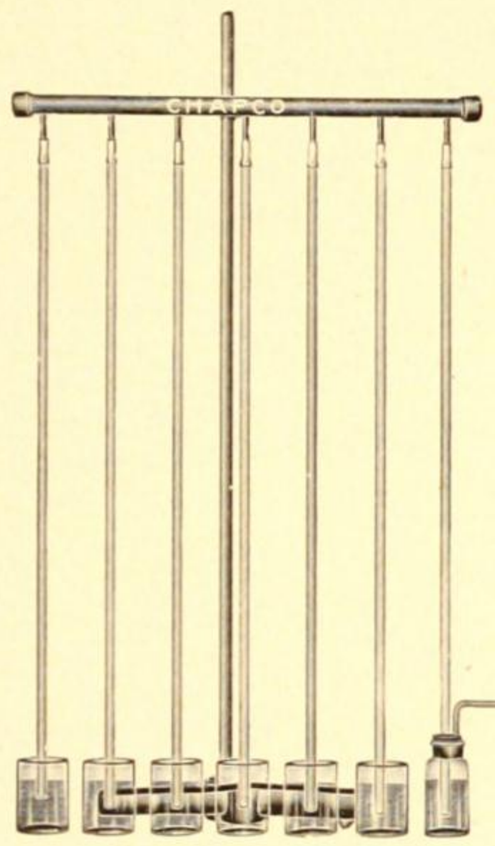
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No. 344R.



No. 349R.



No. 354R.

339R. Faucet, Demonstration, Compression. Regulation size and construction, cut open as shown in illustration. All parts are left free to move to show their office in "shutting off" or "turning on" of water in a compression bibb **$2.50**

340R. Faucet, Demonstration, Fuller. Regulation size and construction, cut open as shown in illustration. All parts are left free to move to show their office in "shutting off" or "turning on" of water in a Fuller bibb **$2.50**

344R. Hare's Balancing Column Apparatus. For finding the specific gravity of a liquid by balancing and comparing a column of the liquid with a column of water. Consists of two 105 cm. glass tubes connected at the top by a glass Y-tube, two glass tumblers, and rubber tube with pinchcock..... **$1.00**

349R. Hare's Balancing Column Apparatus. According to Ahrens, Hurley and Burns. For determining the density of six different liquids at one time. Consists of a metal tube with clamp for attaching to support rod and having six outlets on one side; six rubber connectors; six 6 mm. x 75 cm. glass tubes; six 2¼x3¼ inch glass jars; and a glass overflow trap with outlet tube and pinchcock. Suction applied to the outlet tube of the glass trap (by air pump or any other means) raises the liquids in the glass tubes to heights proportional to their densities. A splendid demonstration apparatus. Without tripod base and support rod..... **$5.00**

352R. Hare's Balancing Column Apparatus. Milvay. Complete form. The two glass tubes, connected at the top by a Y-tube fitted with a suction tube, are mounted on a wood back. By the side of each tube is mounted a sliding scale provided with a pointer at its lower end. The tips of the pointers are the zero points of the scales. Consequently, when the scales are lowered until the tips of the pointers touch the surface, the heights of the liquids in the two glass tubes may be read directly from the scale. The wood back can be raised upon its support rod while the tumblers are being filled. The scales read to 100 cm. in mm. Complete with support and two tumblers **$15.00**

354R. Hero's Fountain, Glass. For showing how water is raised by the elastic force of air. Total height about 35 cm. **$2.00**

Milvay Hydraulic Press Model—5 Tons

355R. Milvay Hydraulic Press, 10,000 lb. Working Model. New design with inclosed reservoir. At first the hydraulic press was used principally in the baling of cotton. Today it plays an important role in modern manufacturing processes where tremendous pressures are needed. The molding of Bakelite and other insulated compositions, the fabrication of highly compressed laminated material from which "silent" auto gears are made, the forming of large complicated parts of steel, and the shaping of spectacle lens blanks are just a few typical examples. Because of its present great industrial importance, we have given the production of a lecture table model more than usual attention.

This has resulted in many improvements and new features which make the Milvay the most compact, convenient and powerful press for demonstration work. No other model offers so many advantages.

1. Enclosed reservoir. The pressure transmitting fluid (oil) is not exposed to the air. Prevents splashing and its attendant mess. Keeps dirt out, preventing abrasion and wear of the pistons, the scratching or wear of which would cause leakage. No other model has this exclusive Milvay feature.

2. Pointer Does Not Recoil. It remains at the point of maximum pressure. It permits accurate determination of the snap point of cast iron, cast brass, certain woods, and other material that break abruptly. It prevents pointer bending by banging against zero pin. Slow return of pointer to zero is controlled by the slight turn of a wheel-handled valve. No other model has this Milvay feature.

3. All Metal Connections. No rubber hose or other material subject to deterioration is employed. All connections are metal. They cannot leak. They assure permanent service. Another exclusive feature.

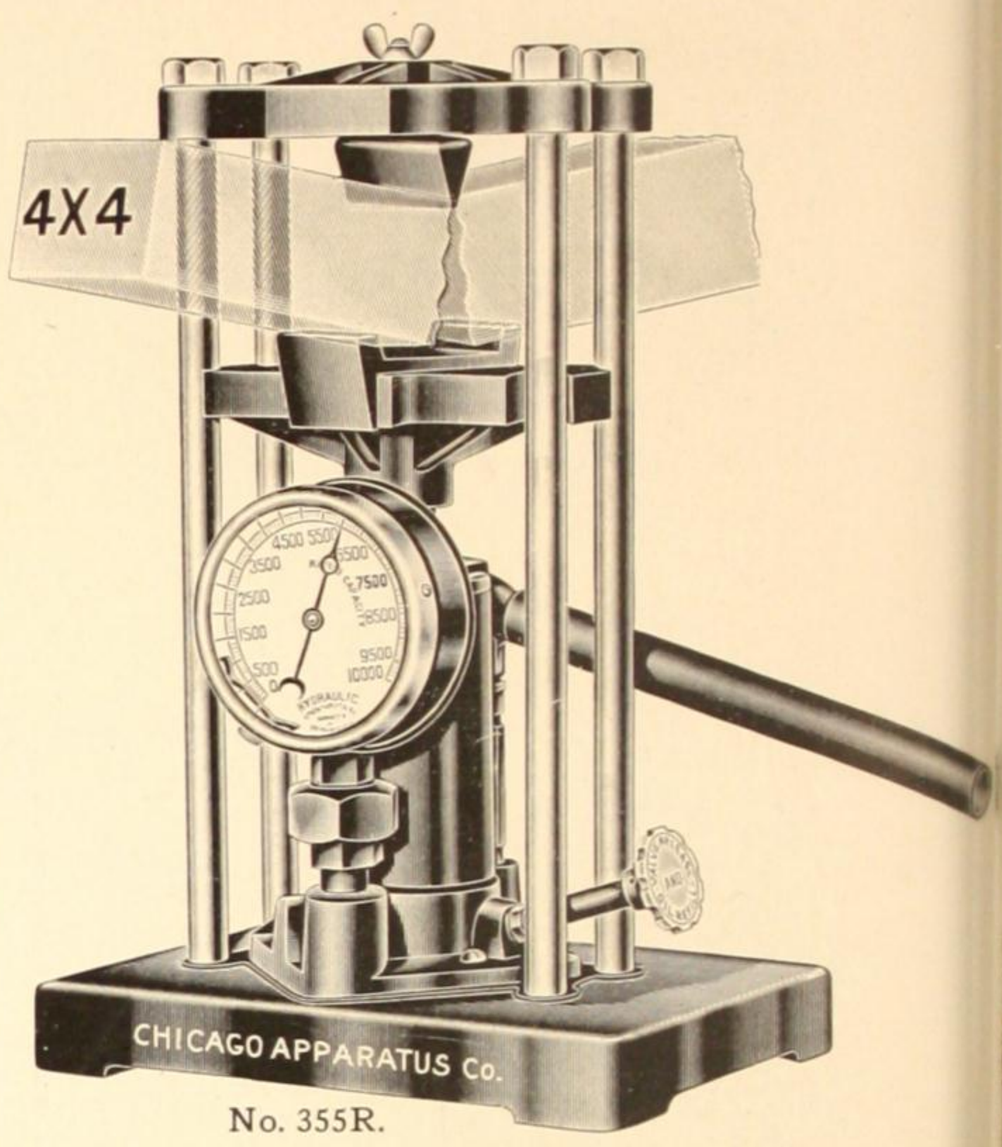
4. Simple Pressure Release Valve. A slight turn of a disk-handled valve permits the return flow of the oil to the inclosed reservoir. This valve is located at the bottom of the press proper. Fresh or additional oil is easily introduced by completely unscrewing this valve.

5. Exposed Pistons. Permits accurate measurement of their diameters with a caliper and calculation of the mechanical advantage of the press.

6. No Ungainly Projecting Parts. In the Milvay all parts fall within the base. This protects it against injury by coming into contact with other objects in the apparatus case. Occupies less space and makes handling easier for an article that must of necessity be quite heavy. It also improves the general appearance of the entire instrument.

7. High Mechanical Advantage. The area ratio of the small to large piston is 8 to 1. The lever ratio of the handle is 8.5 to 1. This gives a high mechanical advantage of 68 to 1. From this it is evident that only a moderate handle pressure will produce a tremendous press pressure.

How to determine the mechanical advantage and piston pressures. The hydraulic gauge on the Milvay indicates pressure in pounds per square inch. Knowing the area of the pistons, it is then a simple matter to calculate the pressure on each piston. The area of the large piston is 1.227 square inches. The pressure on the large piston is therefore 22.7% greater than the gauge indication. Thus, after bending ½ inch diameter steel rod, the gauge will read 1140 lbs., but the actual pressure exerted by the large piston is 122.7% of this amount, or 1400 lbs. The area of the small piston is .15 sq. inches. The



No. 355R.

pressure on the small piston is therefore 15% of the gauge indication. In the example given above, this would be 15% of the 1140 lbs. or 181 lbs. Since the lever ratio of the handle is 8.5 to 1, the handle pressure (not allowing for friction) is 21.3 lbs. Dividing 1140 lbs. by 21.3 lbs. equals 68—the mechanical advantage of the press since the full diameter of the pistons are exposed and since the handle is easily removable, all dimensions may be determined by direct measurement, making possible thorough laboratory as well as lecture work with this new Milvay Hydraulic press.

Specifications

Large Piston—Diameter 1.25 inches—areas 1.227 sq. inches—maximum distance of travel 4.25 inches—number of strokes required, 50.

Small Piston—Diameter $\frac{7}{8}$ inches—area .15 sq. ins.

Handle—length 12 inches—removable—slip out construction.

Mechanical Advantage—68 to 1.

Press Platform—9x17 cm.

Upper and Lower Fulcrums—distance between, 53 mm.—both removable—distance from end to end of lower fulcrum, 128 mm.

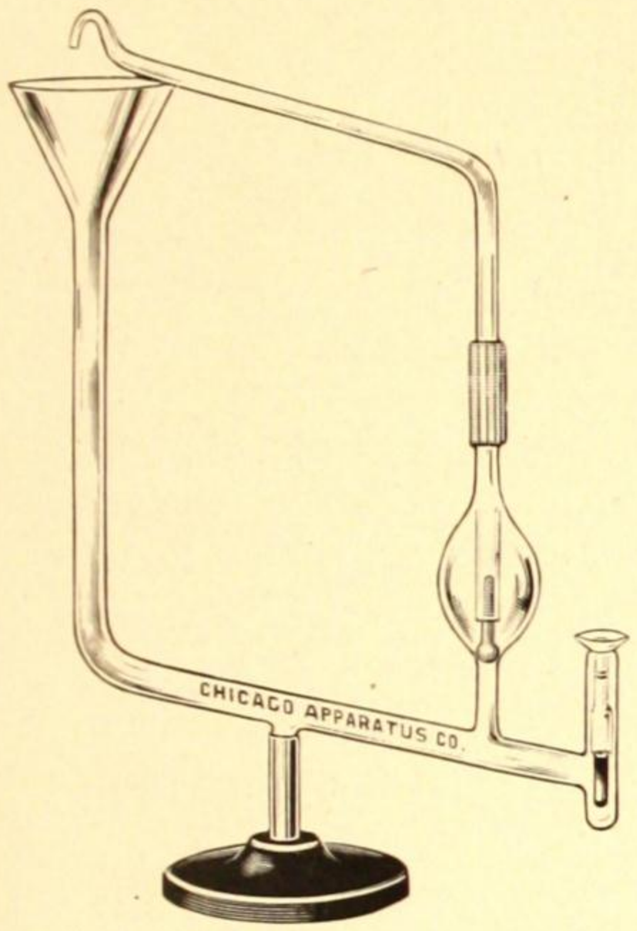
Gauge—Standard Hydraulic type—registers in pounds pressure per square inch—reads to 10,000 lbs.—diameter, 120 mm. New form with zero-position corrector.

Extreme Height of Press—50 cm.

Size of Base—23x31.5 cm.

Finish—Press, green enamel—base, press platforms and fulcrums, black gloss enamel—uprights, gauge rim, valves and oil line, polished nickel-plate.

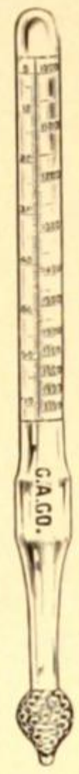
Complete, as illustrated, filled with oil, ready for use **$100.00**



No. 356R.



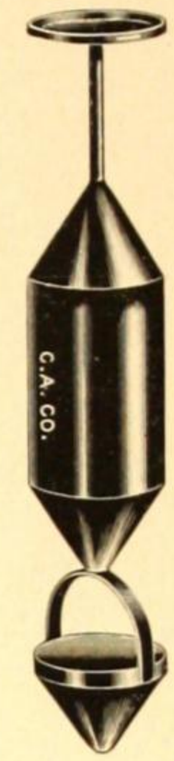
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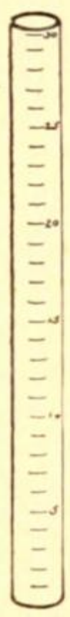
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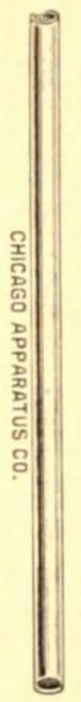
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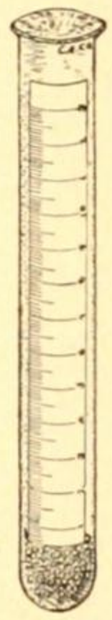
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No. 384R.



No. 389R.



No. 391R.

356R. **Hydraulic Ram.** Working model of glass. For showing how the inertia of a falling body of water may be utilized to raise a portion of this water to a point higher than its source. Mounted on stand as illustrated. Total height, about 35 cm. **$4.50**

359R. **Hydrometer, Demonstration.** Waterproofed wood rod, 1 cm. square, 30 cm. long, weighted to float upright in water, graduated in millimeters. **$0.25**

364R. **Hydrometer, Glass.** For liquids lighter than water. With Baume scale 100° to 10° by 1° divisions, and specific gravity scale 0.600 to 1.000 by 0.005 graduations. Length, about 28 cm. **$0.75**

369R. **Hydrometer, Glass.** For liquids heavier than water. With Baume scale 0° to 70° by 1° divisions, and specific gravity scale 1.000 to 2.000 by 0.01 graduations. Length, about 28 cm. **$0.75**

374R. **Hydrometer, Glass, Universal.** For both light and heavy liquids. Baume scale 100° to 10° and 0° to 70° by 1° divisions, and specific gravity scale 0.700 to 1.000 by 0.005 divisions and 1.000 and 1.900 by 0.01 divisions. Length, about 37.5 cm. **$1.50**

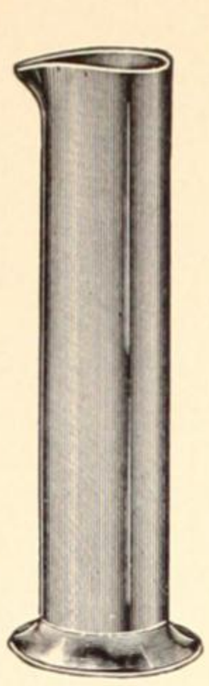
379R. **Hydrometer, Nicholson's.** Constant volume, brass, neatly finished. Length, about 25 cm. . . . **$2.75**

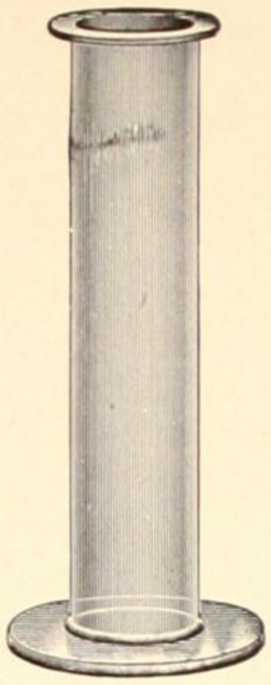
382R. **Hydrometer Tube, Aluminum.** Closed bottom, length 30 cm., diameter 2.5 cm., graduated in cm. Especially designed for use in flotation experiments in Millikan, Gale and Davis' Course and in Dull's Course **$2.00**

384R. **Hydrometer Tube, Constant Volume.** As used in Millikan, Gale and Bishop's Course. Glass about 17 cm. long by 19 mm. in diameter. For use with shot **$0.40**

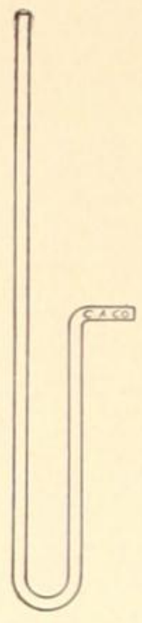
389R. **Hydrometer Tube, Constant Weight.** As used in Millikan, Gale and Bishop's Course. A straight glass tube 60 cm. long by 19 mm. in diameter and closed at one end **$0.45**

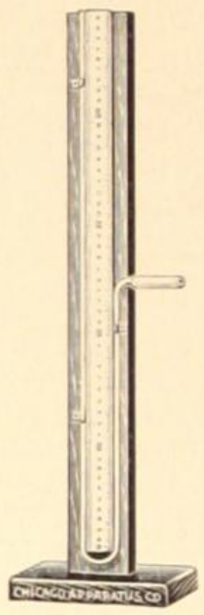
391R. **Hydrometer Tube.** Test Tube Form. 15 cm. long with millimeter scale and loaded to float with about two-thirds of the tube under water. For use in Fuller and Brownlee's Course **$0.95**

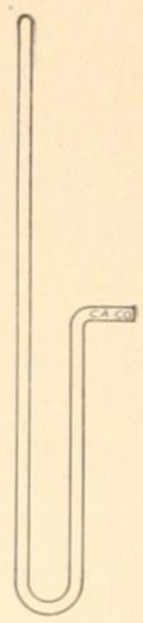

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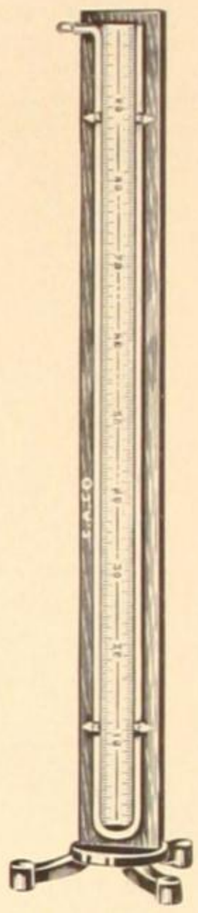

No. 410R.

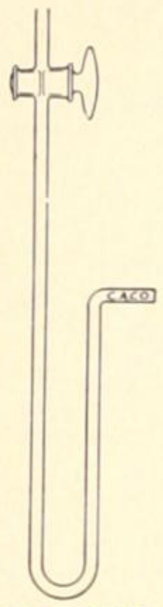

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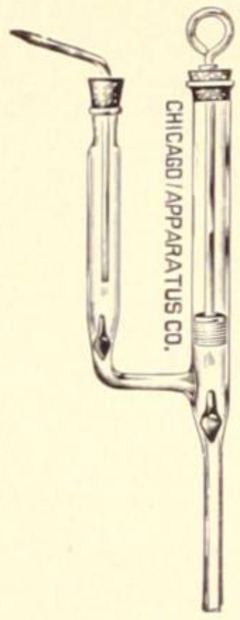

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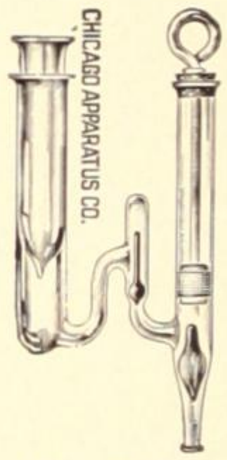

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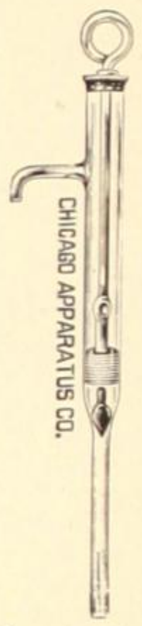

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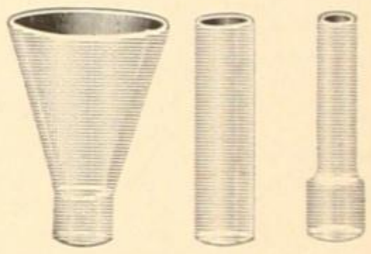

No. 432R.


No. 433R.


No. 434R.


No. 435R.


No. 436R.


No. 449R.

400R. Jars, Hydrometer. Of heavy clear glass, with lip.

Cat. No.	400R	401R	402R	403R
Height inches	10	12	15	18
Diameter, inches	1½	2	2	3
Each	**$0.40**	.50	.65	1.00

410R. Jars, Hydrometer. Of heavy clear glass, with flange.

Cat No.	410R	411R	412R	413R
Height inches	10	12	15	18
Diameter, inches	1½	2	2	3
Each	**$0.45**	.55	.70	1.25

419R. Manometer Jar. As used in Millikan and Gale's Course for comparing the density of two liquids. Consists of 32-ounce bottle, three-hole rubber stopper, inlet tube, pinchcock, and two No. 420R Manometer Tubes **$1.50**

420R. Manometer Tube. Glass, 23 cm. long, same as in No. 419R Manometer Jar **$0.60**

424R. Manometer, Open. After Millikan, Gale and Bishop, for measurement of gas and lung pressure. Glass manometer tube with arms 25 and 50 cm. long **$0.50**

429R. Manometer, Open, Mounted. Manometer No. 424R mounted on a neatly finished hardwood stand with millimeter scale **$3.00**

430R. Mouthpieces. For use with Nos. 424R and 429R **$0.05**

431R. Manometer, Closed. Same as No. 424R, but with the long tube closed at the top **$0.50**

432R. Manometer Gauge, Vacuum and Pressure. Consists of a glass U-tube on polished wooden back with scale one meter long graduated in millimeters. Both arms are open and one end is formed into a hose-end for connection, by means of rubber tubing, to the apparatus in which the pressure is to be measured. When mercury is used this gauge is suitable for measuring pressures from one atmosphere below to one atmosphere above zero absolute, providing a total measuring range of two atmospheres **$6.50**

433R. Manometer with Stopcock. May be used as open or closed manometer. Arms are 25 and 50 cm. long. For use, see Exp. 17, "Exercises in Laboratory Physics," by Millikan, Gale and Davis..... **$1.75**

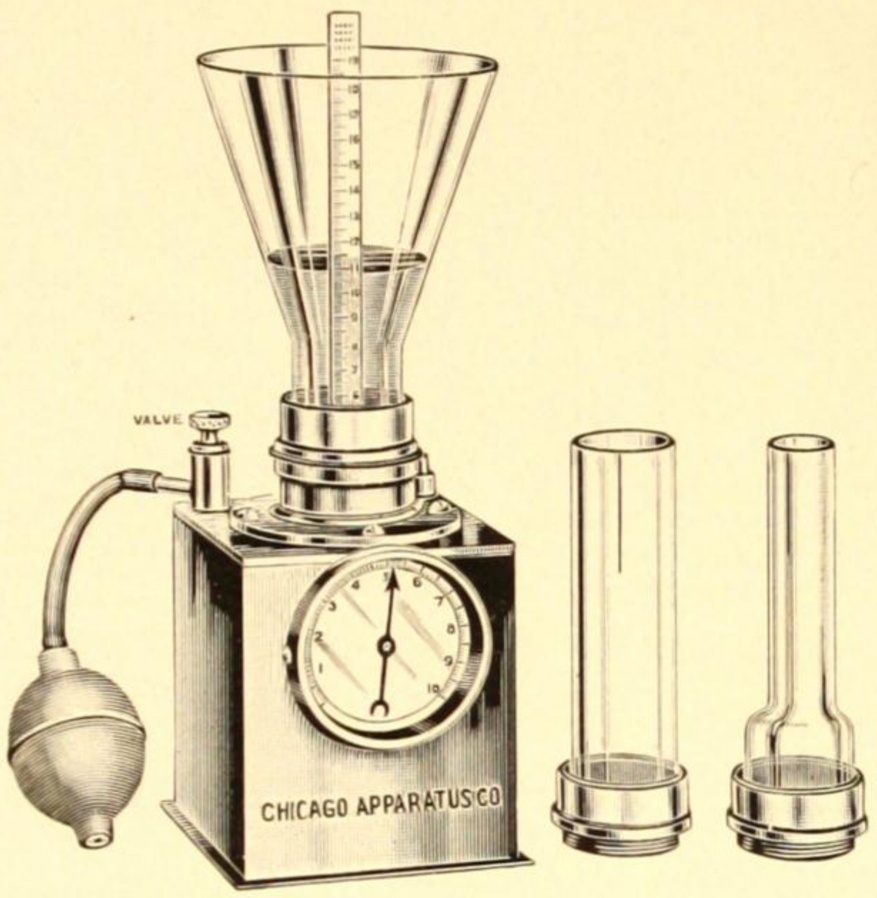
434R. Model Force Pump. Glass working model, with visible valves. Length about 35 cm. **$1.50**

435R. Model Hydraulic Press. Glass working model, with visible valves. Length about 24 cm..... **$2.00**

436R. Model Lift Pump. Glass working model, with visible valves. Length about 35 cm. **$1.25**

449R. Pascal's Vases. (Hydrostatic Paradox Vessels.) As used in Millikan and Gale's Course for showing that the downward force exerted by liquids on the bottom of vessels is independent of shape, but depends on area of base and depth of the liquid. Three glass vessels, 15 cm. high, of different shapes, with ground glass and attached cords..... **$2.00**

New Milvay Pascal's Vase Apparatus



No. 461R.

461R. Pascal's Vase Apparatus, Milvay New Reservoir-in-Base Type, with Depth Scale. The feature which distinguishes this new model from all others in the reservoir-in-base. This provides a compactness, convenience and rapidity never before attained in a Pascal's Vase Apparatus.

Exclusive Features

1. Reservoir-in-Base. Ten seconds of pumping fills the large vessel with water; the smaller vessels in correspondingly less time.

2. Perfect Control. The return-flow valve allows the water to fall accurately and quickly to any desired level, and to hold it at any level.

3. Very Rapid. Pressure readings for various and corresponding depths in all three vessels can be made in a fraction of the time required with other models.

4. Extremely Compact. Occupies about one-fifth the space of other models. Easier to handle and store. Base, 12x12 cm.; overall height, 33 cm.

5. Convenient Depth Scale. Permits accurate depth adjustments and determinations. Graduated to 19 cm. in mm.

6. Correct Dial Indications. The simple, sensitive and durable mechanism indicates pressures accurately for all depths.

7. Protected Mechanism and Pointer. The sensitive mechanism is completely enclosed. The pointer swings in a glass-covered casing. A perforated metal guard is located directly above the diaphragm. This construction affords the most complete protection and insures long life.

8. Fine Construction and Appearance. The one-piece metal reservoir and base and all other metal parts are of high-class workmanship, while the finish yields a most pleasing appearance.

9. Standard-Sized Glass Vessels. Each is full size. 15 cm. high.

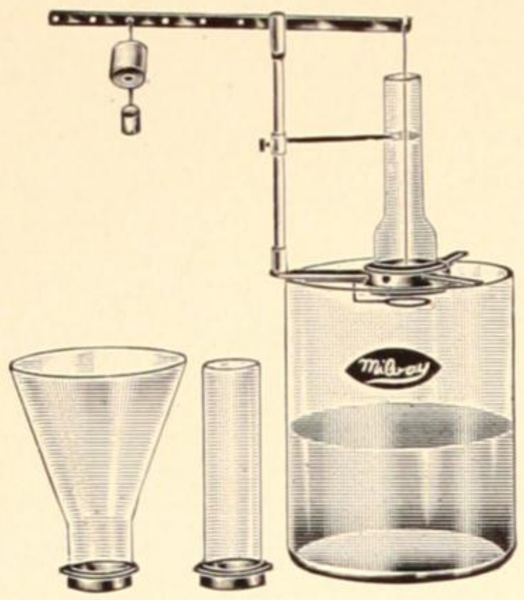
10. No Ungainly or Clumsy Projecting Parts. Our new design for the first time eliminates the ungainly and clumsy supports, sliding reservoir, pointer, scale and other projecting parts characteristic of older models. It gives to the new Milvay a real instrument appearance.

Considering its low price and many advantages—rapidity — compactness — accuracy — convenience—instrument appearance—and fine workmanship, it exceeds in value any Pascal's Vase Apparatus at any price **$20.00**

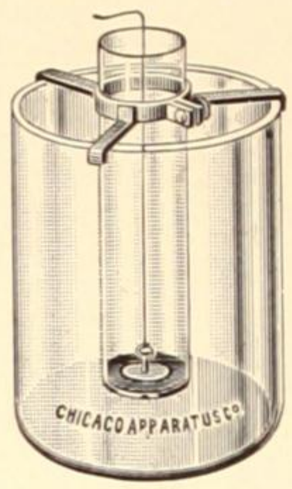
461Ra. Extra Funnel Tube, with threaded brass fitting attached, to fit No. 461R. For replacement **$2.25**

461Rb. Extra Contracted Tube, with threaded brass fitting attached to fit No. 461R. For replacement **$2.25**

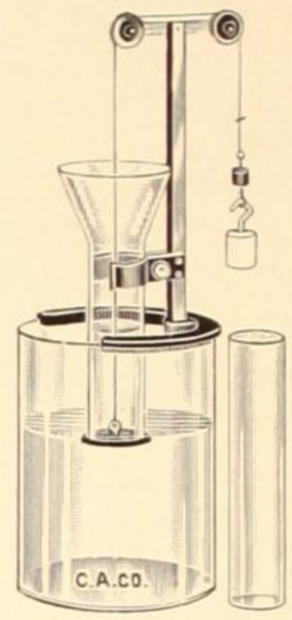
461Rc. Extra Straight Cylindrical Tube, with threaded brass fitting attached, to fit No. 461R. For replacement **$2.25**



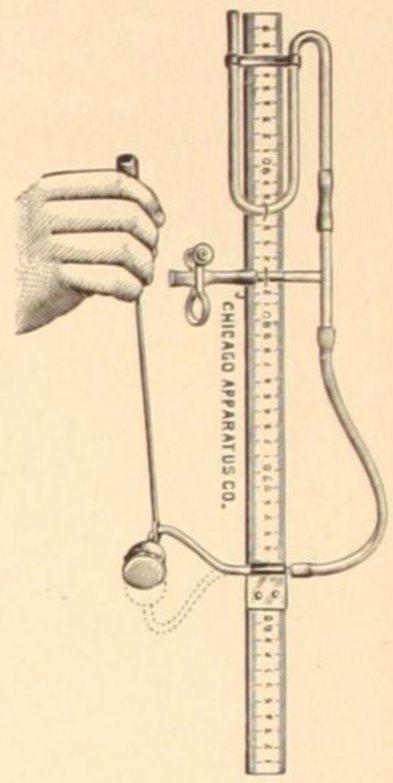
No. 464R.



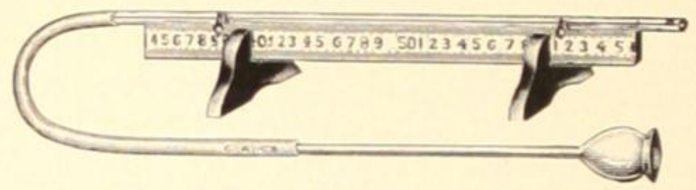
No. 470R.



No. 472R.



No. 479R.



No. 474R.

464R. Pascal's Vases. Complete form with jar, balance arm and weights. For demonstrating that pressure is independent of the shape of the containing vessel. The brass casting for supporting the vessels of different shapes is provided with a standard which carries at its top a pivoted balance arm or lever. On the short arm is attached a hanger, bearing a brass disc, ground to fit the cylindrical part of the above mentioned casting. The long arm is provided with a number of equally spaced holes for holding hook weights. An index attached to the standard indicates the height of the water in the vessel. Complete as illustrated **$13.50**

469R. Pressure Apparatus. For demonstrating upward and downward pressure of liquids. Consists of a glass cylinder, 5x17.5 cm., one end ground to fit brass disc attached to a cord..... **$1.75**

470R. Pressure Apparatus. Same as No. 469R, but with the addition of a brass support for holding the glass cylinder upright and 6x8 inch battery jar.. **$2.50**

471R. Pressure Apparatus. Same as No. 469R, but with the addition of a metal support for holding the glass cylinder upright in a 6x8 inch battery jar. As illustrated, but without battery jar..... **$2.00**

472R. Pressure Apparatus, Milvay Improved Form. For demonstrating downward pressure, upward pressure, and that pressure is independent of the shape of a vessel. To show downward pressure the cylindrical vessel is clamped into position and the metal disk counterpoised against its bottom. By successively adding weights and water it can be shown that the greater the depth the greater the pressure against the disk.

When used to show upward pressure the jar is nearly filled with water. The cylinder held in the clamp and with the disk counterpoised against its bottom is lowered 3 to 4 inches down in the water. The upward pressure of the water will now support the disk. Water is then poured into the cylinder which when it reaches to the level of the water outside will counteract the upward pressure and the disk will fall of its own weight.

To show that pressure on the bottom of a vessel does not depend upon the shape of the vessel, nor the weight of the water in it, water to a given depth is first counterpoised in the cylindrical vessel and then to the same depth in the funnel-shaped vessel. In both cases the counterpoise weight will be the same, showing that the downward pressure must also be the same.

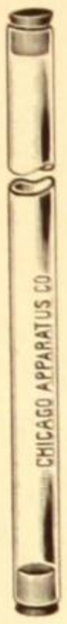
The apparatus consists of a glass jar, one cylindrical vessel, one funnel-shaped vessel, metal disk, one counterpoise weight, and support with clamp and Bakelite pulleys. Complete, as described and illustrated **$6.50**

474R. Pressure Gauge. As used in Millikan and Gale's Course. Consists of a straight glass indicator tube mounted on a millimeter scale, 30 cm. long, with wooden supports. The indicator tube is connected by rubber tubing to a thistle-shaped glass bulb provided with a rubber diaphragm..... **$1.25**

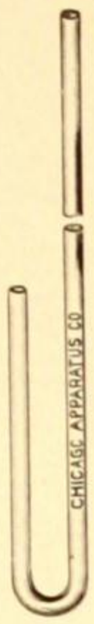
479R. Pressure Gauge. Hall's Latest Form. For showing the relation of liquid pressure to depth. The variations in pressure are indicated by a column of colored liquid held in a manometer tube attached to the upper end of a millimeter scale. At the lower end is a thistle-shaped glass bulb with rubber diaphragm. This bulb is connected to the manometer tube by means of a rubber tube. A side tube is provided between the manometer tube and bulb so that the pressure in the two arms of the manometer tube may be instantly equalized. Total length about 30 cm. **$1.75**



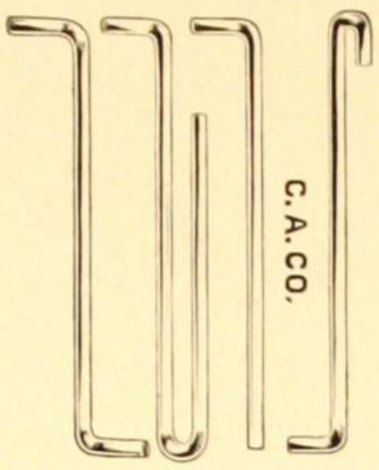
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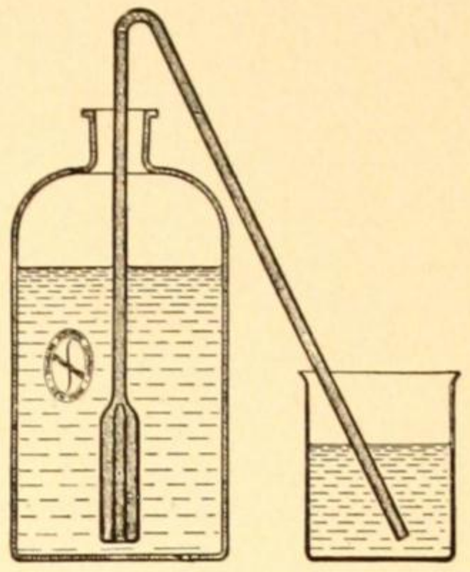
No. 489R.



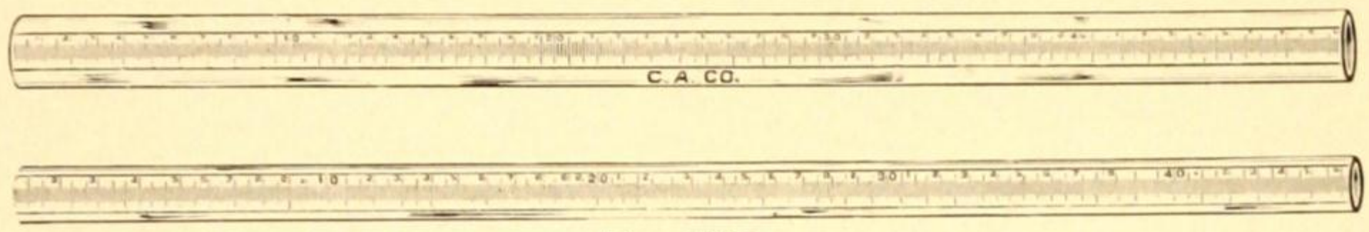
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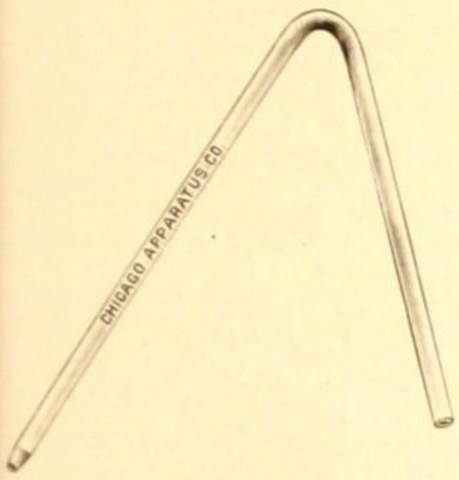
No. 494R.



No. 507R.



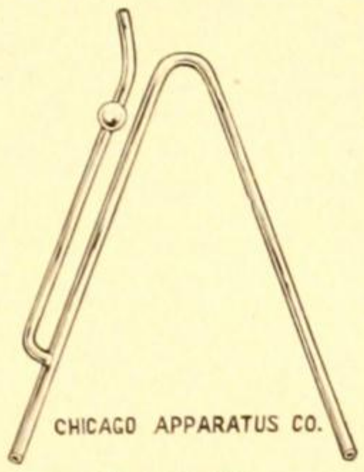
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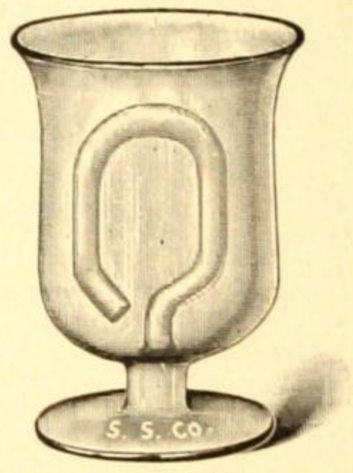
No. 509R.



No. 511R.



No. 514R.



No. 519R.

484R. Pressure Syringe. Glass, 25 cm. long, perforated bulb with piston. For showing that pressure is transmitted equally in all directions by a liquid. **$2.00**

489R. Pressure Tube, Glass. As used in Millikan, Gale and Bishop's Course. Heavy wall, length 110 cm., diameter 4 cm., annealed ends, provided with solid and one-hole stopper **$2.00**

490R. Pressure Tube Manometer. As used in Millikan, Gale and Bishop's Course. For use in connection with No. 489R Pressure Tube in the study of liquid pressures at different depths. Short arm 30 cm. long, other arm 102 cm. long, both arms open **$0.40**

491R. Pressure Tubes Graduated. For use in verifying the laws of liquid pressure as outlined in "Physical Laboratory Manual," by Chute. The tubes, of glass, are closed at one end and provided with paper scales graduated in millimeters. Both are 50 cm. long with diameters of 19 mm. and 25 mm. **Per pair** **$3.40**

492R. Pressure Tube. 19 mm. tube only of No. 491R **$1.60**

493R. Pressure Tube. 25 mm. tube only of No. 491R **$1.80**

494R. Pressure Tubes. Set of four glass tubes 30 cm. long, shaped as illustrated. For measuring the upward, sidewise, or downward pressure of a liquid at different depths **$0.75**

499R. Pressure U-Tube. Glass, 12.5 cm. long; inside diameter of one arm 6 mm., the other 12 mm., making the area of one arm four times that of the other **$0.45**

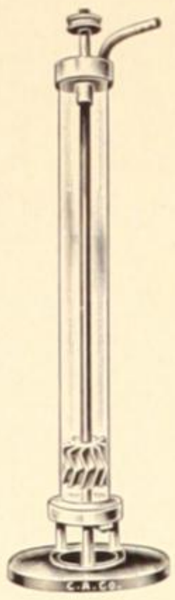
507R. Siphon, Automatic. Flow starts instantly and automatically when bulb is plunged into a liquid. A unique application of the expansive power of air. Superior to suction type siphons for handling acids and other dangerous liquids. Glass, length 30 cm. **$1.50**

509R. Siphon. Plain form, glass, length of delivery tube 30 cm. **$0.40**

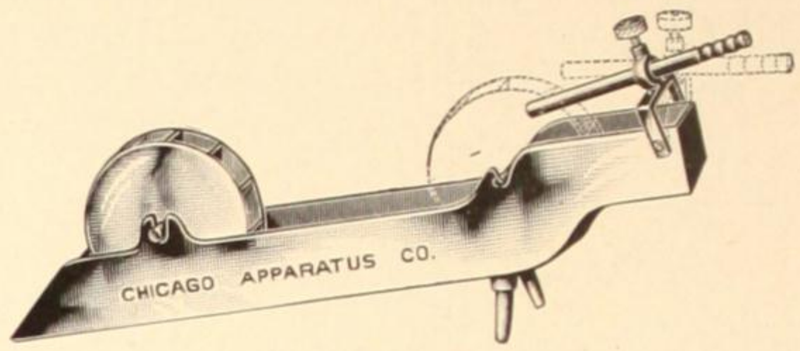
511R. Siphon, Plain U-Form. For demonstration purposes, of 8 mm. glass tubing, with arms 30 cm. long **$0.50**

514R. Siphon. With suction tube, glass length of delivery tube 30 cm. In this form the liquid cannot come in contact with the user's mouth and it is therefore useful in siphoning acids, poisonous liquids, etc. **$0.65**

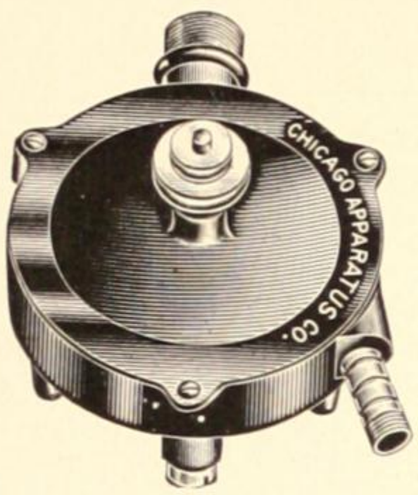
519R. Tantalus Vase. For illustrating the principle of intermittent springs. When water is poured into the glass vessel until the level rises above the curved tube, the siphon begins to act and continues until the vessel is emptied. Height, about 15 cm. . . **$1.50**



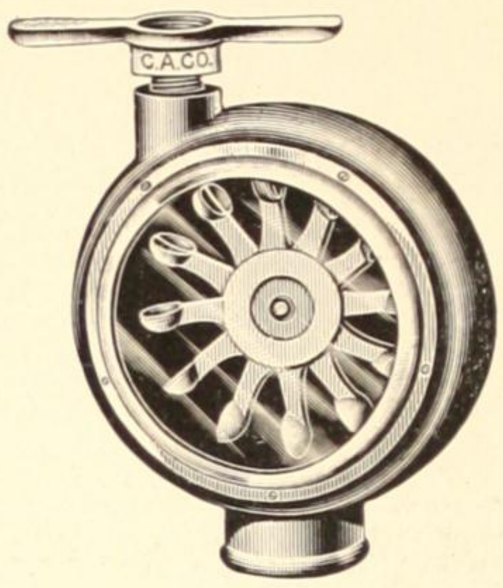
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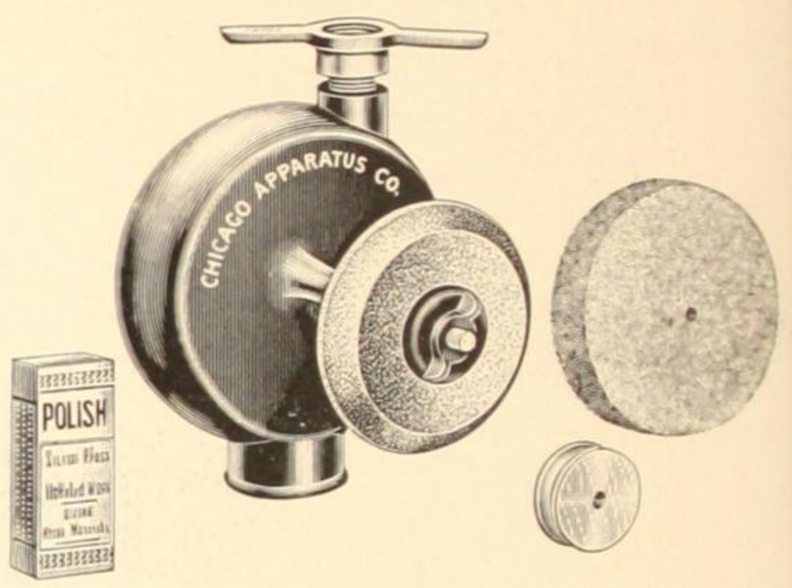
No. 529R.



No. 524R.



No. 526R.



No. 527R.

524R. Water Motor. Will operate on water, steam or compressed air. Diameter, 5 inches. Has a two-speed steel pulley for 7/32 inch round belt. The small pulley is ¾ inch diameter, the large one 1¼ inch diameter. This motor is excellent for stirring or shaking, because it can be easily attached to an ordinary apparatus stand by means of a clamp holder or right-angle clamp. The inlet pipe fits ½ inch rubber hose or tubing. A portion of the inlet pipe is threaded for ¼ inch iron pipe size coupling. The speeds developed by this motor at different water pressures are as follows:

Water pressure, lbs..	20	30	40	50	60
Rev. per minute	2300	2800	3400	3850	4200

An excellent water motor for general laboratory use **$9.00**

525R. Water Turbine, Model of. For illustrating how the gravity pressure of water is utilized in the modern water wheel—the turbine—to develop power. The curved blade runner is mounted at the lower end of the shaft, while a small grooved pulley is attached to the upper end. The casing is of glass, thus exposing the action and all constructional details to view. The water inlet is 13 mm. in diameter. Water from any faucet or from a reservoir elevated slightly above the apparatus will drive the runner at high speed. The apparatus is mounted on a substantial base. Height 42 cm. **$15.00**

526R. Water Motor Outfit, Demonstration Form. Same motor as in No. 527R, but with one side of glass so that the action and construction of the Pelton water wheel may be studied. Furnished complete with all accessories noted under No. 527R.. **$9.75**

527R. Water Motor Outfit, Complete. A reliable motor fully guaranteed, intended for grinding and polishing. Becomes a most efficient bottle and flask washer by simply attaching a wire handle brush on the end of the spindle. From a laboratory standpoint the design is such that efficiency tests can be made to good advantage. Develops one-eighth horsepower with eighty pounds of water pressure. Easily attached to any faucet or water pipe. Outfit includes: four-inch motor, four-inch beveled face emery wheel; felt buffing wheel and cake of polish for brass, copper and silver; wood pulley grooved for $\frac{1}{32}$-inch round belt; and coupling for threaded faucet. Entire outfit is securely packed in neat corrugated box. Weight about six pounds..... **$6.00**

528R. Water Motor, Large Size. Same type of motor as in outfit No. 527R, but six inches in diameter. Develops one-quarter horsepower with eighty pounds pressure. Complete with wood pulley grooved for $\frac{7}{32}$-inch round belt and coupling for threaded faucet, but without other accessories **$10.00**

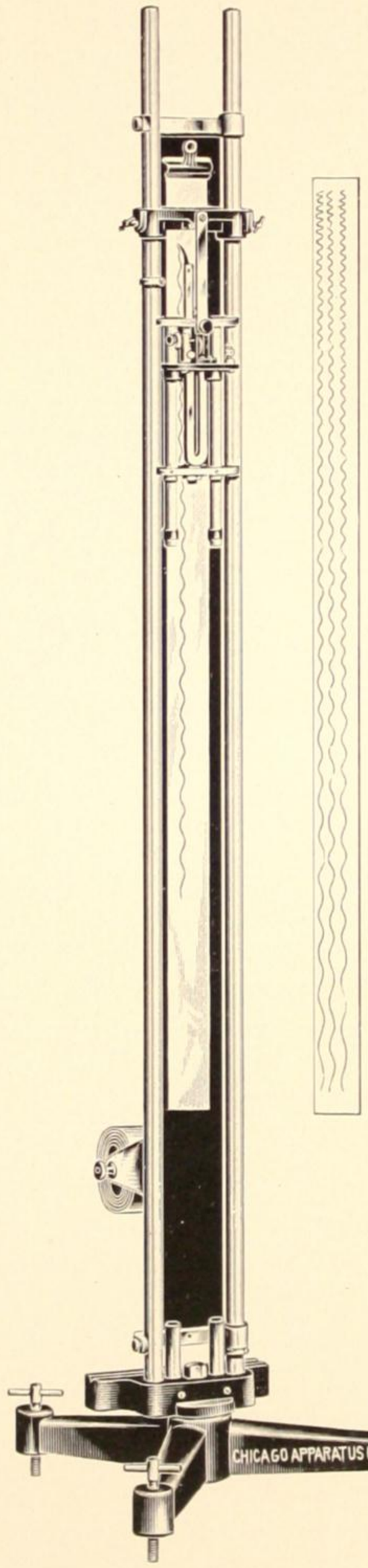
529R. Water Wheel Model, Aluminum, Milvay. For illustrating how water may be made to do work, by the utilization of its weight and kinetic energy due to motion, in various forms of water wheels—overshot, undershot, and breast wheels. All three classes are illustrated by one wheel—10 cm. in diameter—which may be placed in either of the two sets of bearings. The inlet tube—13 mm. in diameter—is adjustable so that the water may be supplied to the wheel from the proper level in each case. The trough measures 38 cm. long. Made entirely of finely finished aluminum **$9.00**



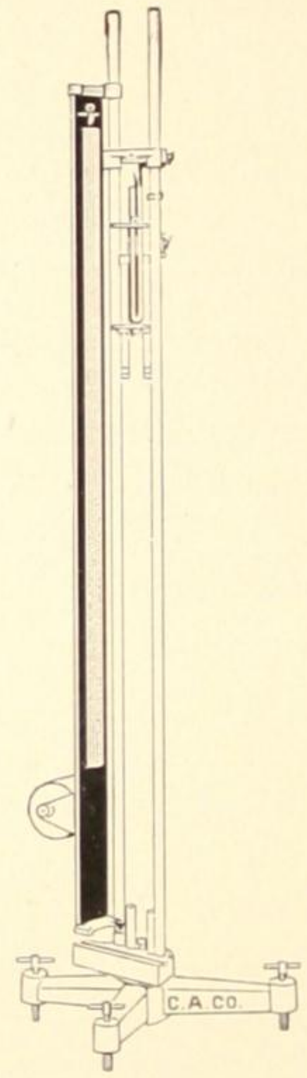
Prepacked Merchandise

MERCHANDISE carried on our stock shelves is prepacked — put up in neatly labeled, sealed unit packages. Prepacking insures quicker deliveries because it reduces the time required to fill and pack orders. It insures the receipt of fresh, clean goods. It promotes accuracy, protecting our customers against the receipt of wrong merchandise and wrong sizes. It makes our shipments, even the largest, easier to check. This important feature of *Milvay* service was inaugurated by us over two decades ago and has won the highest praise from purchasers of laboratory supplies everywhere.

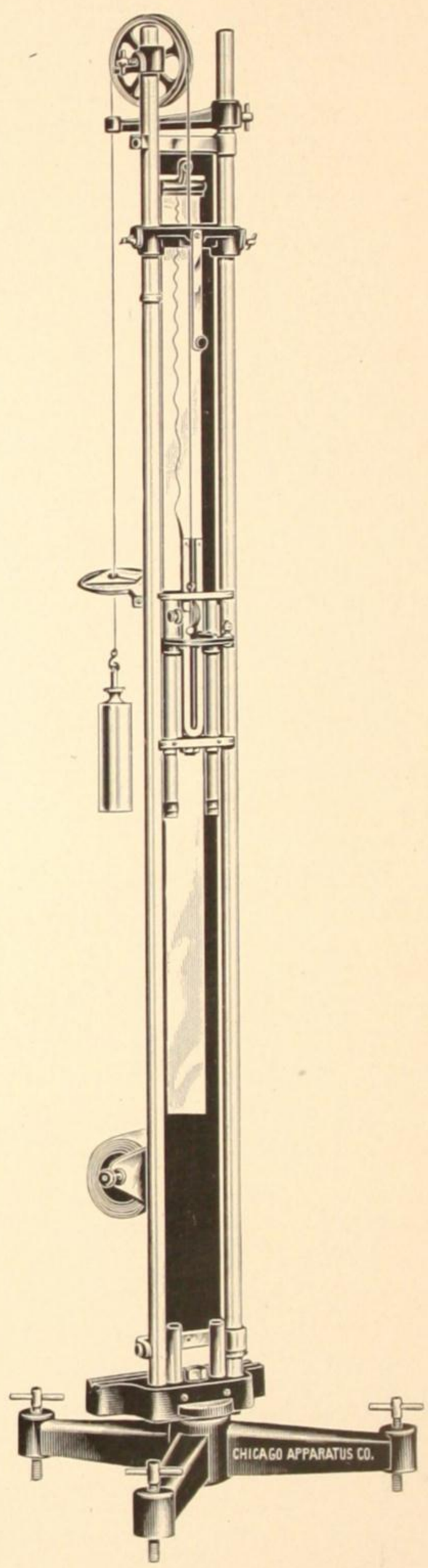
Milvay Improved Acceleration Apparatus



No. 545R. (and Trace Record).



No. 545R.
(Showing Accessibility
of Metal Back
When Swung Out).



No. 545R. with No. 546R. in Place.

545R. **Milvay Waxed-Paper-on-Roll Acceleration Apparatus with Electrically Operated Tuning Fork.** As originally introduced many years ago, this general form of apparatus was equipped with a heavy glass plate which had to be "smoked" or "chalked" before it could be used to record the trace of the fork. Naturally "smoking" or "chalking" this glass plate is a slow and messy job. Then, too, breakage renders the apparatus useless until a new glass plate is secured. Further, the one glass plate supplied limits the use of the apparatus to a few students or to lecture purposes. The use of additional plates is costly and inconvenient.

To overcome these disadvantages and to insure results of greater accuracy we have developed a new design possessing exclusive features that will appeal to progressive physics teachers.

The heavy glass plate has been replaced by a smooth metal plate against which lies a strip of waxed paper for receiving the tracings of the falling fork. The metal plate can be moved sidewise so that three to four tracings, one alongside the other, can be made on the same strip of paper. When one set of tracings has been completed the hinged metal plate is swung back and the strip of tracings torn off. Another strip is unrolled and its free end inserted in the clamp at the top of the metal plate. A slight reverse turn of the roll, which is held under spring tension, takes out any slack in the paper, causing it to lie flush against the metal plate. The plate is then returned to its former position when the apparatus is again in readiness for the making of further tracings.

Obviously, the making of tracings with this improved apparatus is simple, quick, convenient and clean. Also, it is evident that an entire class can be supplied with tracings within a very short space of time. Furthermore, such tracings can be made a part of the students' permanent record of the experiment.

To insure greater accuracy and more uniform results, many other improvements and refinements have been incorporated in this new model. Thus, the plate has been moved closer to the tuning fork so that a shorter and stouter stylus could be employed, thereby assuring perfect traces free from irregular stylus motions. The tuning fork is accurately rated at 100 V.P.S., insuring greater time-interval accuracy and simplifying the calculation of results. Greater clearance has been provided between the tines of the fork and the core of the electro magnet, permitting the fork to vibrate at maximum amplitude without interference, thus insuring traces of maximum width and distinctiveness. Because of these refinements, determinations of the value of "G" correct to within ½% are readily obtainable.

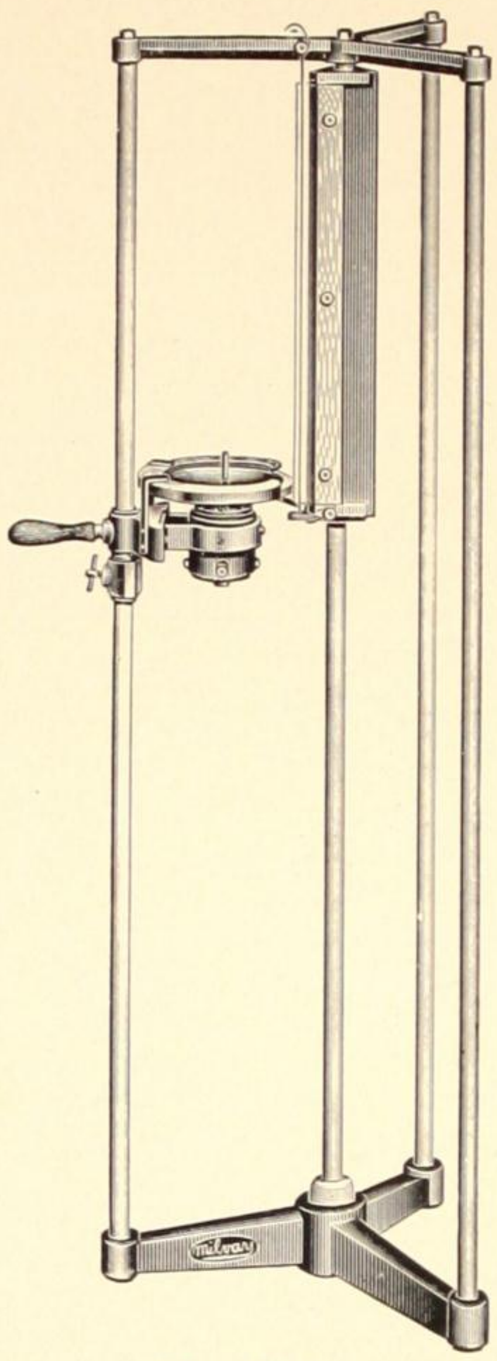
The falling carriage is freely guided between two highly polished and nickel-plated steel rods. The fork is electrically operated and this insures uniform amplitude of vibration throughout its fall. The exact crests of the waves can therefore be located, even at the lower end of the trace. A battery current of 3 volts will maintain the fork at maximum amplitude of vibration. "Air cushions" at the base noiselessly and smoothly arrest the carriage at the end of its fall. A stop at the upper end prevents the stylus from striking the top cross-bar, protecting it against injury.

The apparatus is mounted on a heavy iron tripod with three nickel-plated levelling screws. It stands more than 165 cm. high and the carriage has a free fall of 115 cm. The construction is substantial throughout and the finish and workmanship the finest. The roll of waxed paper supplied is sufficient for making about 40 sets of traces.....**$60.00**

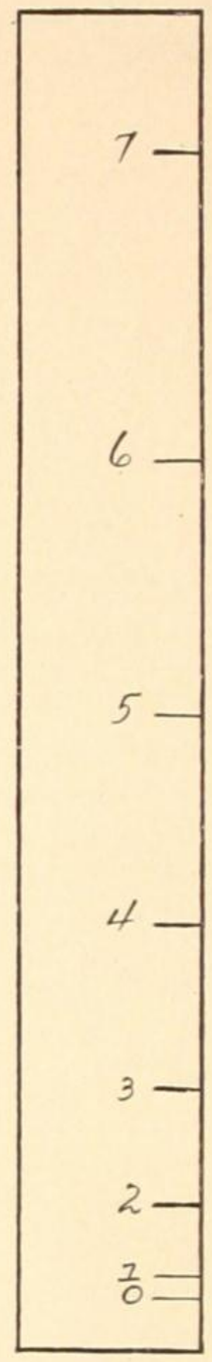
546R. **Atwood Attachment for No. 545R.** This attachment enables the above apparatus to be used also as an Atwood machine. Consists of a light aluminum wheel, a counter-poise weight, one each 10, 20 and 50 gram rider weights, "stop" clamp and an adjustable platform. The counterpoise weight is hollow and slightly lighter than the falling carriage of No. 545R. By removing the hook and introducing lead shot the weight of the counter-poise can be readily brought into accurate agreement with that of the falling carriage. The wheel is so mounted that it can be readily attached to the top of one of the vertical guide rods of No. 545R as shown in the illustration. Since the wheel is mounted on fine ball bearings it turns freely with a minimum of friction. The falling carriage is attached to a cord passing over this wheel and holding on its other end the counter-poise weight. The stop clamp is attached to the top of the other vertical guide rod and the cord passed through the opening in it. This stop prevents the counter-poise weight from striking and injuring the delicate wheel. The platform can be attached at any point along the metal plate and has an opening in it that will pass the counter-poise weight while picking off the rider weights. By taking traces with riders of different weights, Newton's Second Law of Motion can be verified. By use of the adjustable platform the accelerating force (riders) can be removed. The carriage will then continue to move upward without acceleration, the trace becoming uniform.....**$26.00**

547R. **Milvay Waxed-Paper-on-Roll Acceleration Apparatus and Atwood Machine Combined.** Consists of No. 545R and No. 546R.....**$86.00**

548R. **Extra Roll of Waxed Paper** for No. 545R. Width 2 inches, length 150 feet.....**$1.50**



No. 549R.



(Slit Record—
1/5 Size—Made
by No. 549R).

549R. Acceleration Apparatus, Milvay Motor-Driven Slit-Record Type. For verifying the laws of uniformly accelerated motion. Offers these distinct advantages:

1—More accurate and uniform results than the falling tuning fork and inclined plane method.

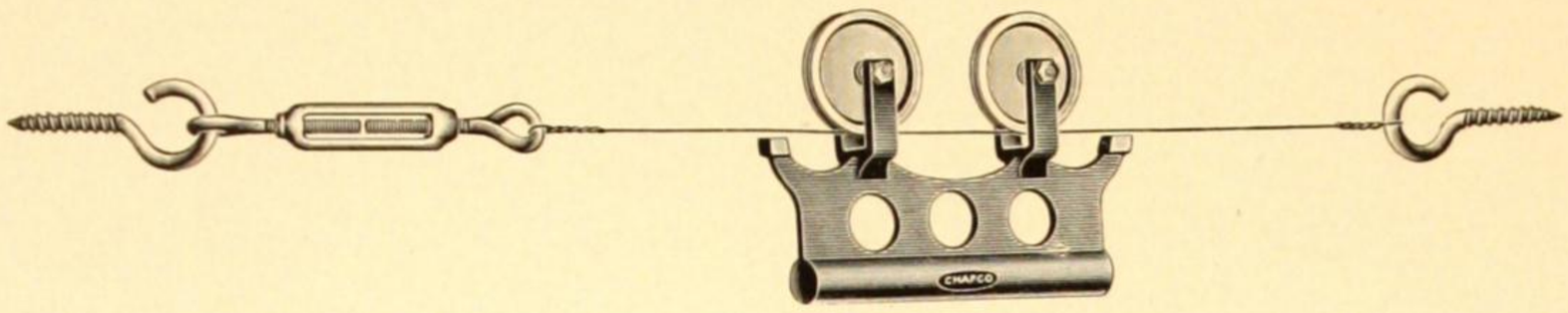
2—Employs a freely-falling, not a rolling or counterpoised body. Elimination of friction insures greater accuracy.

3—More compact. Only 54 inches high by 18 inches wide.

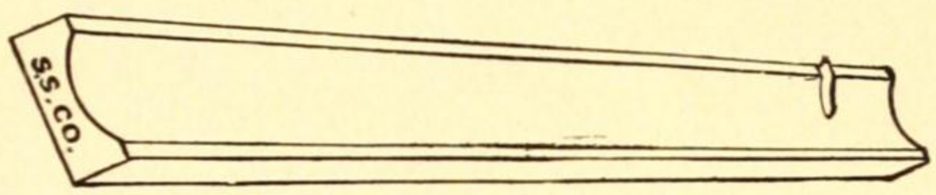
4—Rugged, rigid and durable. No delicate parts or adjustments.

5—Combined lecture and laboratory piece. Makes one record per minute—no two exactly alike. Even a large class can be quickly supplied with records for individual work. Consists of a heavy iron tripod; four nickel-plated 54x¾-inch rods; three-armed top bracket; 6 lb. hollow metal prismatic falling body, with full-length clamp for holding record strip; and a swing-mounted motor, with revolving knife blade. Motor operates on 6 volts, runs on end ball bearing with a speed of about 3000 R.P.M. A collar permits adjustment of motor to the proper height. When a cardboard strip is clamped to the prismatic body which is held against the top by a string, and the speeding motor moved against the left stop, the revolving knife blade cuts the string and one fine slit in the edge of the record strip at each successive motor revolution as the body descends. From this record the distance fallen in each successive equal time interval is obtained by direct measurement. Each time interval is equal to one motor revolution. From this data the laws of uniformly accelerated motion may be determined and verified. By determining the speed of the motor the value of "g" may be calculated. Including 100 record strips.....**$75.00**

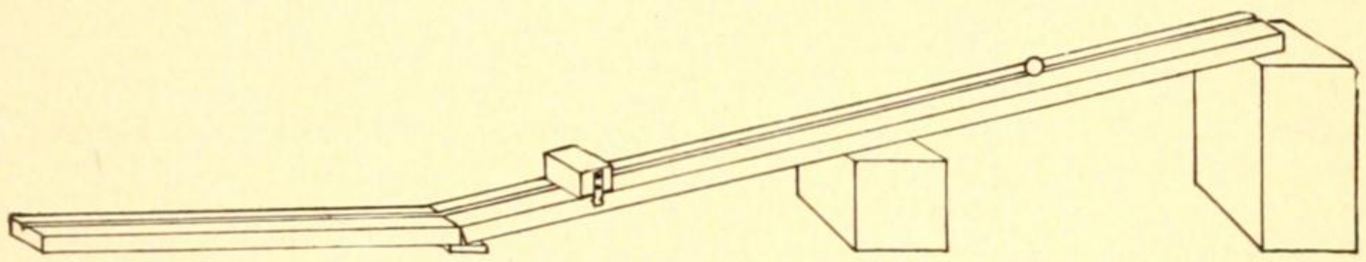
549Rs. Record Strips. For No. 549R, in packages of 100 .....**Per package $0.60**



No. 550R.



No. 554R.



Nos. 556R-557R (in Use).

550R. Acceleration Apparatus. (Inclined Plane and Car.) The inclined plane in this apparatus consists of a wire, both ends of which are provided with hooks. In addition, one end is provided with a turnbuckle for drawing the wire taut. The car, about 15 cm. long, is of japanned iron and has two cone bearing pulleys. By setting the wire at different angles the car may be made to descend at various accelerations. As a consequence, a most careful study of the laws of accelerated motion may be made. Complete with 50 feet of wire.....**$3.75**

554R. Acceleration Apparatus, Duff's. (Inclined Plane.) After Dr. A. Wilmer Duff, Worcester Polytechnic Institute. A plank 2 inches thick, 60 inches long and 5 inches wide with a wide, shallow groove on one surface. When in a horizontal position a steel ball placed in the groove will oscillate back and forth at a definite period. When in an inclined position the ball will roll down the center with accelerated motion. By releasing the ball at one side of the groove the two motions are combined. If the groove be covered with a thin film of lycopodium powder the steel ball will trace a curve from which quantitative determinations of accelerated motion may be made. Complete with steel ball and releasing mechanism **$5.50**

556R. Acceleration Apparatus. (Inclined Plane.) After Millikan and Gale. For determining the relationship existing between the distance traversed by a falling body and the time of fall. Consists of a wood plank 16 feet long, 4 inches wide and 3 inches thick with an accurate "V" groove along its entire length down which a 1-inch steel ball may roll. With wooden block stop, but without ball.....**$18.00**

557R. Acceleration Apparatus. (Inclined Plane.) Exactly the same as No. 556R, but only 8 feet long. When placed at the bottom of No. 556R, at a slight inclination so as to eliminate friction, the rolling steel ball is freed from the force of gravity and moves along at the velocity it had when it reached end of the 16-foot incline. This additional 8-foot plane is, therefore, convenient for determining the relationship existing between the time of fall and the velocity of a falling body.....**$9.00**



No. 571R.



No. 590R.



No. 600R.



No. 605R.



No. 610R.



No. 615R.

Balls Drilled for Suspension

The following balls are suited to pendulum, collision ball and impact work. Each one has a small hole—about $\frac{1}{16}$ inch diameter—clear through the center so that they can be conveniently suspended from cords.

559R. Balls, Aluminum. Accurately finished.

Diameter, inches	¾	1
Each	$0.30	.50

560R. Balls, Brass. Accurately turned.

Diameter, inches	¾	1	1½
Each	$0.15	.30	1.25

565R. Balls, Copper. Accurately finished.

Diameter, inches	¾	1	1½
Each	$0.55	.75	1.75

570R. Balls, Cork. Accurately turned.

Diameter, inches	¾	1	1½
Each	$0.12	.15	.20

571R. Balls, Iron, Cast. Accurately turned the same as No. 605R Steel Balls.

Diameter, inches	¾	1	1½	2
Each	$0.20	.35	.75	1.25

575R. Balls, Ivory. Accurately turned and polished, genuine ivory. Diameter 1 inch $2.50

580R. Balls, Lead. Accurately molded.

Diameter, inches	¾	1	1½
Each	$0.15	.20	.40

585R. Balls, Wood, Lignum Vitae. Accurately turned, much harder and heavier than maple. Used exclusively on collision ball apparatus.
Diameter, 1½ inches $0.25

590R. Balls, Wood, Maple. Accurately turned.

Diameter, inches	¾	1	1½	2
Each	$0.10	.10	.12	.20

Balls—Not Drilled

The following balls are suited for use with grooved inclined planes, grooved collision ball outfits, and in experiments on density and volume measurements.

600R. Balls, Glass. Marbles.

Diameter, inches	¾	1
Dozen	$0.25	.50

605R. Balls, Steel. Hardened, ground and polished.

Diam., in.	½	¾	1	1½	2
Each	$0.06	.08	.20	.45	1.25

Balls with Hooks

The following balls are useful in inertia and impact experiments.

610R. Ball, Cast Iron, Japanned. (Inertia Ball.) Diameter 3 inches, with 3 suspension loops as illustrated $1.25

615R. Ball, Steel. Diameter 1 inch, with two loops for bifilar suspension as in No. 690R Collision Ball Apparatus $0.45

Ball Assortment

616R. Ball Assortment. An ideal assortment for use in impact, inertia and pendulum experiments. Includes 1—No. 560R Brass Ball one inch, 1—No. 580R Lead Ball 1½ inch, 4—No. 585R Lignum Vitae Balls 1½ inch, 1—No. 590R Maple Ball 1½ inch, 1—No. 610R Iron Ball 3 inch. All are either drilled or provided with suspension loops. As will be noted this set includes both elastic and inelastic balls $3.00

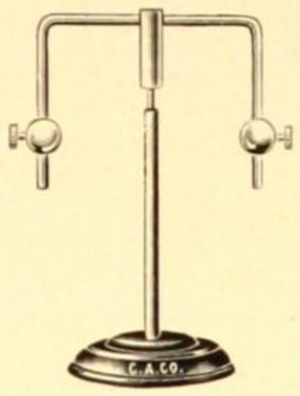
CENTER OF GRAVITY APPARATUS



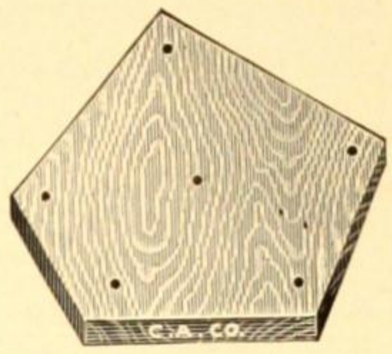
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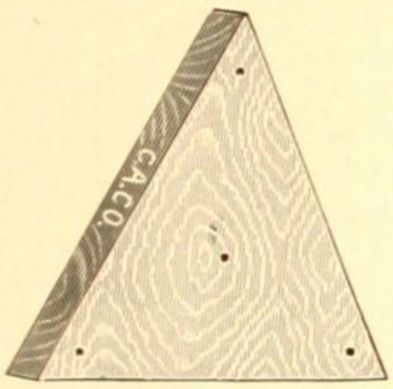
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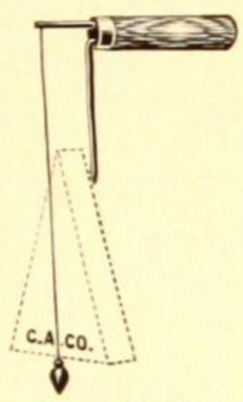
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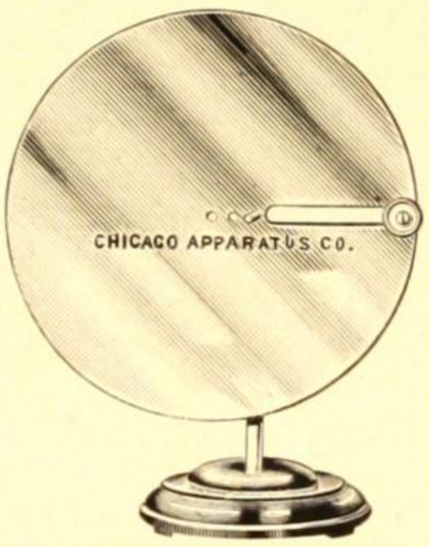
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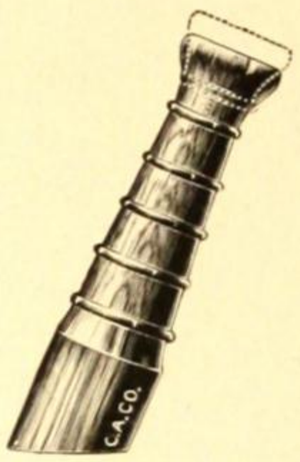
No. 644R.



No. 649R.



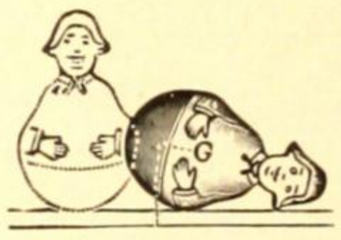
No. 660R.



No. 664R.



No. 709R.



No. 669R.

625R. **Center of Gravity System.** Two balls of unequal mass joined by a rod 15 cm. long, in which holes have been placed at the geometrical center and at the center of mass. When supported by the handle at the center of mass the system is in neutral equilibrium **$0.85**

629R. **Horse and Rider.** The horse balances on his hind legs because the center of mass, due to the heavy ball weight, is under the point of support. Made entirely of wood. Total height, 28 cm... **$1.10**

634R. **Equilibrium Balls.** The balls are adjustable so that the different states of equilibrium are readily illustrated. On metal stand, total height 19.5 cm. **$2.25**

639R. **Irregular Block.** Maple, greatest diameter about 17.5 cm.; 22 mm. thick. Holes are drilled at the corners and in the center, by means of which the block can be supported with No. 649R Handle. **$0.60**

644R. **Triangular Block. Maple,** 15x15x15 cm.; 22 mm. thick. Holes are drilled at the corners and in the center, by means of which the block can be supported with No. 649R Handle..... **$0.55**

649R. **Handle for Blocks.** Hardwood handle, 10 cm. long, with two pins, one for supporting No. 644R or No. 639R Blocks, the other for plumb bob.. **$0.50**

814R. **Plumb Bob.** Iron, weight about 10 ounces. **$0.20**

660R. **Loaded Wheel.** With support. Metal disk 15 cm. diameter with three holes near center and a weight at one side which may be adjusted so the center of gravity is at any one of the holes.... **$2.00**

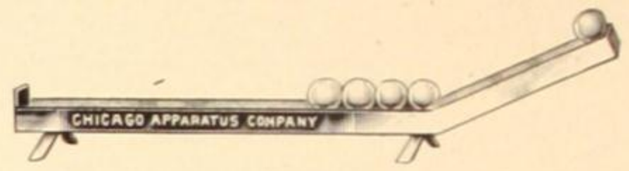
709R. **Double Cone and Inclined Plane.** Of finely finished hardwood. Cone placed on bottom of incline appears to run up the plane, the bars of which diverge so that the axis (center of mass) of the cone actually descends. Length, 40 cm..... **$1.50**

664R. **Leaning-Tower.** With removable top. Made of finely finished hardwood, about 25 cm. high. Stable with top removed because center of mass is within base. Unstable with top in place because center of mass is outside of base..... **$1.50**

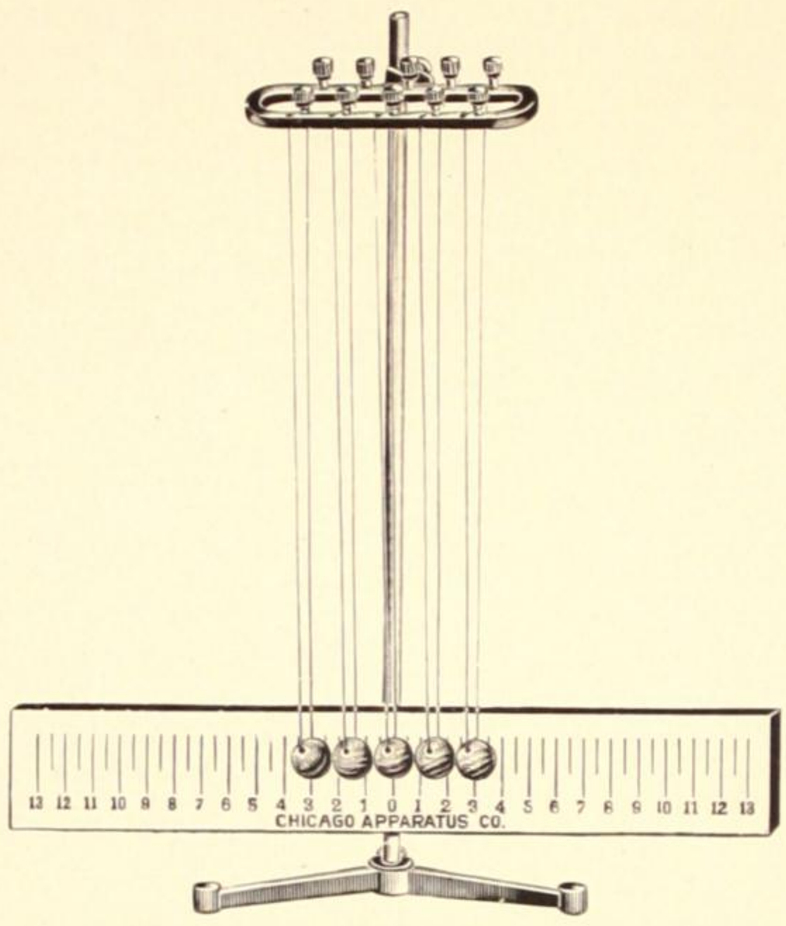
669R. **Witch.** Small celluloid figure with leaded base, for illustrating stable and unstable equilibrium. **$0.15**



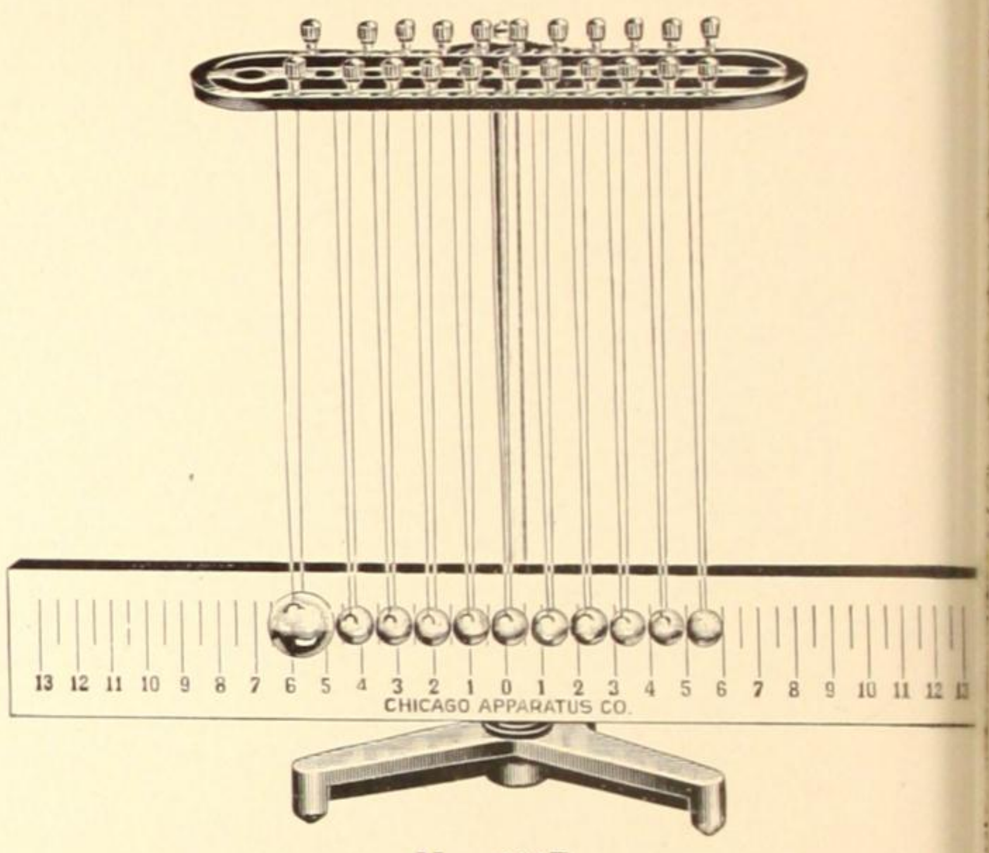
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No. 676R.



No. 681R.



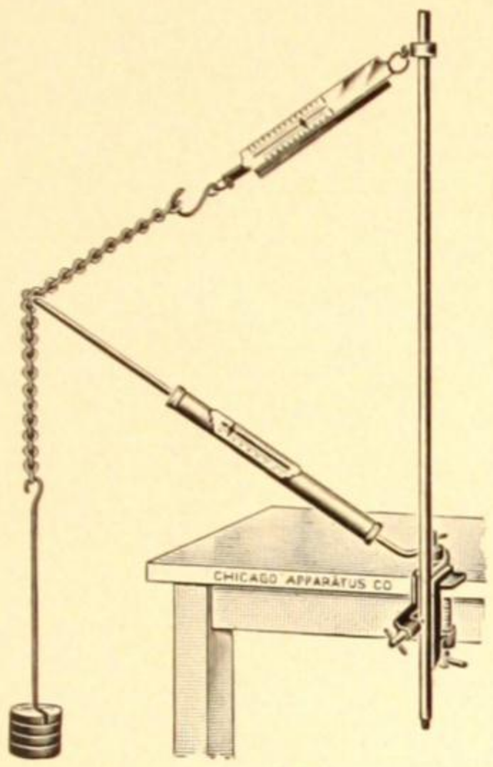
No. 690R.

674R. Collision Balls. Finely finished wood base, 100x12.5 cm., with V-groove, provided with end supports. Complete with seven highly polished glass balls 1½ inches in diameter..... **$2.50**

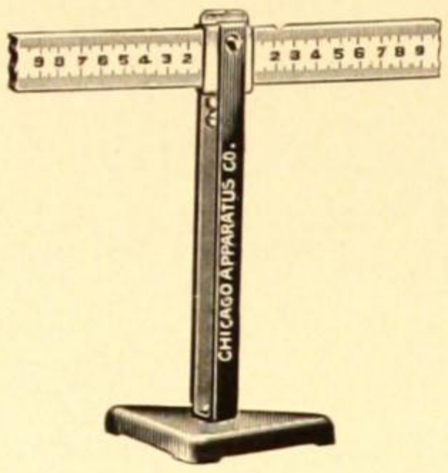
676R. Collision Ball Apparatus with Incline. Better and more convenient than ordinary straight track types. By placing the impacting mass (one or two balls) at the top of the short incline and allowing it to roll down, it develops just the proper momentum for effectively illustrating Newton's third law of motion. Made entirely of metal, finely finished, 50 cm. long, complete with five 1-inch steel balls..... **$3.50**

681R. Collision Ball Apparatus, Standard Form. For studying Newton's third law of motion. Consists of an iron frame, adjustably mounted on a tripod support with rod 100 cm. long, from which are suspended 5 highly elastic lignum vitae balls 1½ inches in diameter. The upper ends of the cord are attached to keys fitted into taper sockets of the iron frame. A turn of these keys quickly and easily brings the balls into perfect alignment, while the bifilar suspensions provide the proper directive force to the balls. The arc, graduated to 13 inches on each side of center by ½-inch divisions, is clamped to the lower part of the rod. The entire apparatus is finished in a most pleasing manner **$9.00**

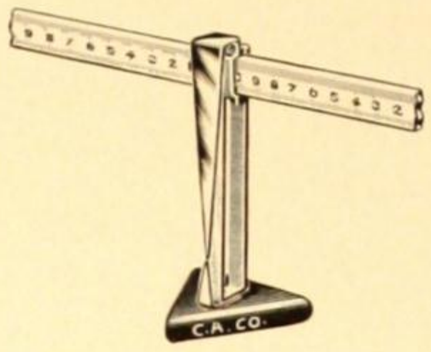
690R. Collision Ball Apparatus, Milvay Improved Form. Consists of ten highly elastic steel balls 1 inch in diameter and one $1\frac{9}{16}$ inches in diameter (almost exactly four times the mass) suspended from a metal frame adjustably mounted on tripod with rod 60 cm. long. The upper ends of the cord are fastened to taper keys fitted in the sockets of the frame. A turn of these keys easily and quickly brings the balls into perfect alignment, while the bifilar suspensions provide the proper directive force to the balls. Running through the center of the frame is a bar with cavities in which to place balls, the service of which are not required in some experiments. For quantitative work a scale, graduated to 13 inches on each side of center in ½-inch divisions, is clamped to the lower part of the rod. The entire apparatus is finely and durably finished **$22.00**



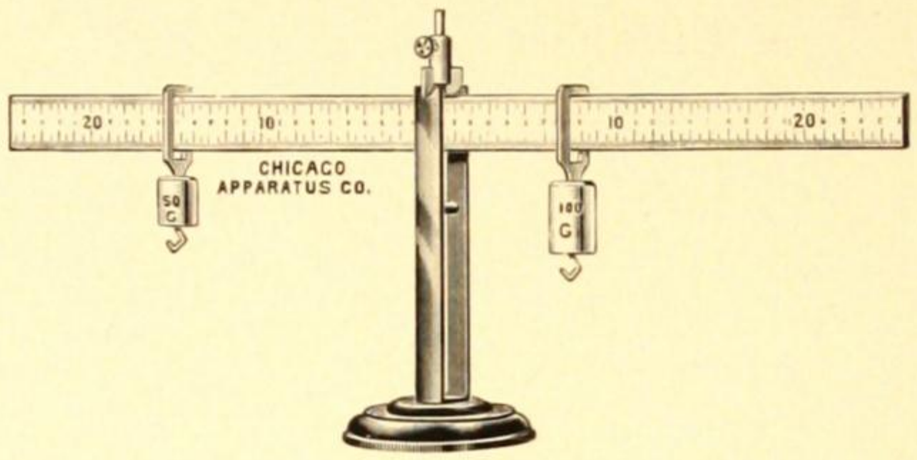
No. 700R.



No. 704R.



No. 705R.



No. 706R.

700R. **Crane Boom, Milvay Improved.** For use in experiments on the composition and resolution of forces. The construction of this new model is such that jamming of the spring is impossible, hence eliminating the erroneous readings which result from this source. The spring is of the compression type, which has several distinct advantages over the extension type. It can be overloaded without danger of injury. No fittings are attached directly to the spring. Fittings attached to a spring never stay set, and when they shift they introduce errors. Furthermore, the mounting of the movable member reduces friction to a minimum. The adjustment is such that the indicator reads 0 when the boom is in a horizontal position. With the boom in the vertical position the indicator reads 300 grams, which is the weight of the moving member plus that of the chains. At the lower end is a rod bent at right angles to the length of the boom. When supported by a table clamp, as illustrated, it provides an axis about which the boom may be rotated. There are two chains at the upper end, each 56 cm. long; one for the "load" weights, the other for engaging the hook of the spring balance employed to measure the "guy" strain. The over-all length, exclusive of the chains, is 104 cm. The barrel is 27 mm. in diameter. Finished in black with graduations in white. The capacity is 15 kilograms in 1/5th kilo divisions. All other parts are finished in white nickel-plate. From a standpoint of performance and quality, the Milvay is undoubtedly the finest Crane Boom on the market today. Quantity production makes possible the low price we have placed upon it.....**$9.00**

NOTE: As outlined on page 3 of "General Physics for the Laboratory," by Taylor-Watson-Howe, the following constitutes a complete equipment for experimental work on the elementary crane: 1 No. 700R Crane Boom, 1 No. 134B Spring Balance, 1 No. 85T Table Clamp, 1 No. 154T Support Rod, 1 No. 103T Hook Collar, 1 No. 336B Weight Hanger, 2 each No. 331B Weights—1, 2 and 5 Kilo; 1 No. 49B Balance, 1 No. 352B Set of Weights, 1 No. 358M Meter Stick.

704R. **Demonstration Balance, Milvay Improved Design with "Stay-on" Lever Holder Feature.** This new design offers two advantages: 1. It prevents the lever holder and meter stick from falling off the support. 2. It prevents loss of the lever holder. Consists of black enameled support with lever holder to fit standard meter stick. Height, about 18 cm. Mounted on triangular non-wobbling base. For use in experiments on the principle of moments as described in Millikan and Gale's Course. Without meter stick **$0.60**

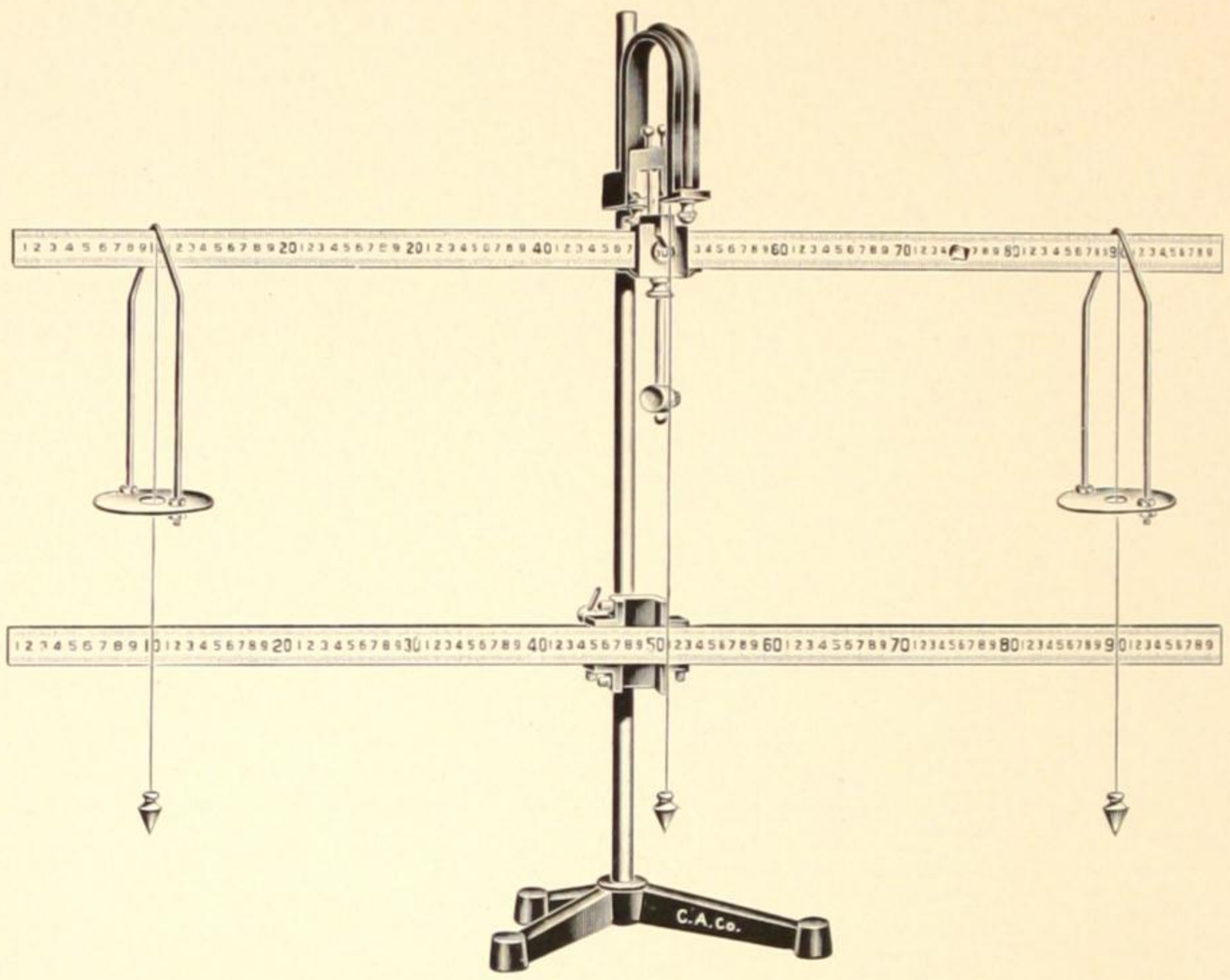
705R. **Demonstration Balance with Pointer.** Same as No. 704R, but with metal index pointer attached to the lever holder. This design is better suited for lecture purposes. Without meter stick.....**$1.25**

706R. **Demonstration Balance, Improved New York Design.** The weights are provided with knife edge stirrups. This offers many advantages over the old side open knife edge type. The stirrups prevent the weights from falling off the meter stick. They make for greater ease and convenience in the adjustment of the weights along the meter stick. They make it easier to read the exact position on the meter stick. The clamp which supports the meter stick on the metal stand is provided with an adjustable knife edge. This construction makes it possible to raise the knife edge above the linear center of the lever as well as above the center of gravity of the lever. One 50 gram and one 100 gram weight is furnished. This is sufficient for all ordinary work in demonstrating the laws of the simple lever, etc. Other combinations may be tested by purchasing extra weights, listed below. Complete as illustrated, with special half-meter stick graduated 25-0-25 cm. in millimeters, special knife edge clamp, two special weights and metal support **$2.35**

707R. **Knife Edge Stirrup Weight.** 50 gram, of No. 706R **$0.50**

708R. **Knife Edge Stirrup Weight.** 100 gram, of No. 706R **$0.60**

Milvay Demonstration Balance
Precision Type



No. 712R.

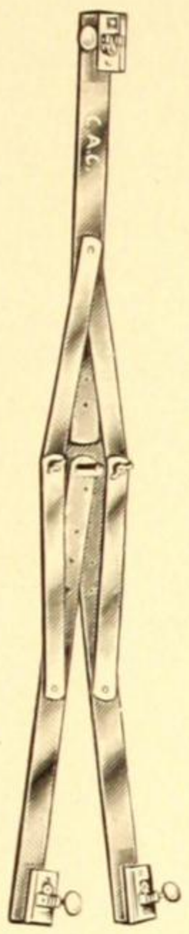
712R. Demonstration Balance, Precision Type, Milvay Improved Form. For the quantitative study of the principle of moments. Also valuable in illustrating the features of a balance and in studying the theory of weighing.

The meter stick, or beam, is provided with a sliding index which may be clamped at any desired point. This index carries a fixed knife edge and another knife edge adjustable vertically. A knife edge also is permanently inserted at the 75 cm. point for use in the determination of the mass of the beam. A notch is cut in the stick 10 cm. from each end. In them, two pans with knife edges are hung. The pans have a hole in the center to clear the plumb bob cords. The three plumb bobs are attached and second meter stick provided so that the horizontal distances between the knife edges can be conveniently measured. The entire system is suspended by resting either of the index knife edges in grooves in the support. The grooves are adjustable so that the center of gravity of the balance may be shifted.

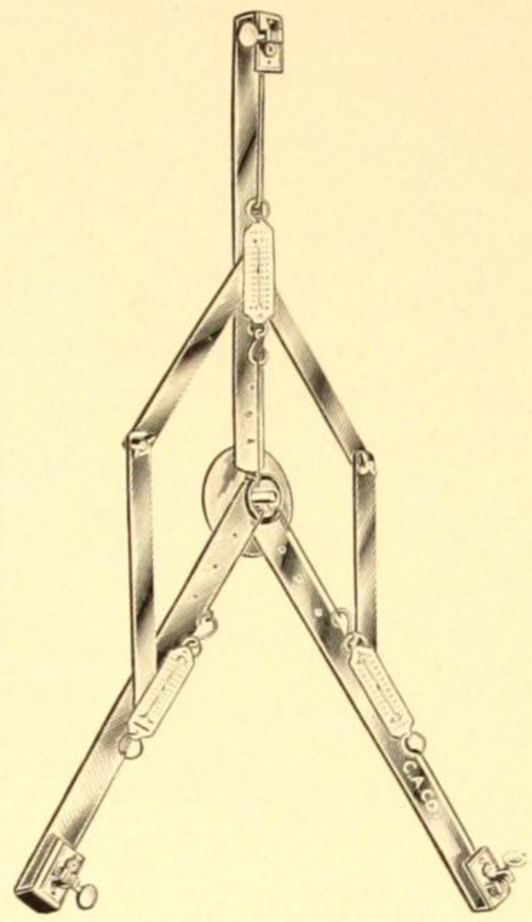
Since this instrument is carefully designed for quantitative work many determinations are possible, such as: Quantitative measurements of the weights of the pans; finding the center of gravity of the system, and determining its mass by setting up an equation of moments on the center of gravity; determination of the sensitiveness of a balance for different loads and different positions of the center of gravity, illustrating the effect of false balances, etc.

This apparatus is well adapted to the needs of the following experiments: No. 4 in Millikan and Mills, and No. 2 in Taylor, Watson and Howe.

Complete as illustrated.....**$30.00**



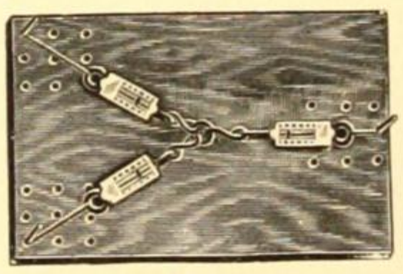
No. 713R.
(Folded for Storage.)



No. 713R.
(Open for Use.)

713R. **Milvay All-Metal Force Apparatus, Tension-Key Type.** In this new apparatus are embodied improvements which make for greater convenience and greater accuracy in composition of force experiments. The tension keys at the end of each arm provide a new and nicer method of adjusting the force along each arm and of centering the ring about its peg. One arm is rigidly welded to the central base plate, while the other two are hinged at the center. This arrangement permits two arms to be moved to any desired point and the angles between all three arms varied to any desired degree. The hinged guides between the stationary and movable arms can be securely locked by means of the two wing nuts, thus preventing accidental change in the angular position of the arms. Three holes in each arm coincide with the direction of the line of applied force.

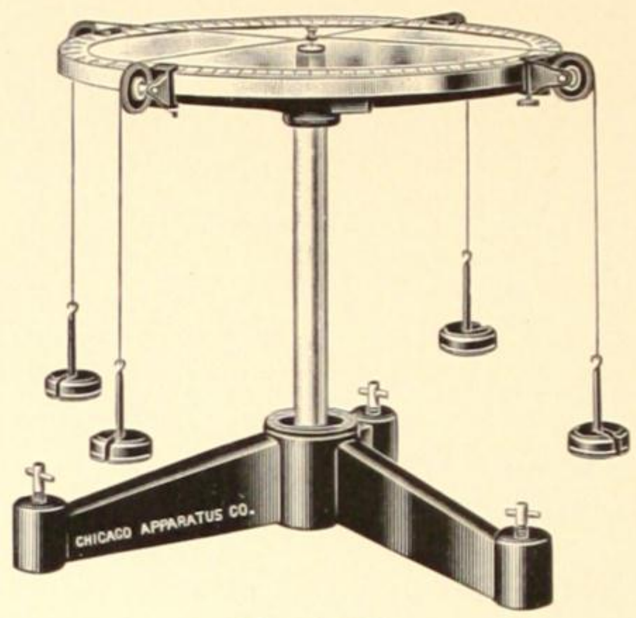
By placing the apparatus over a sheet of note paper the position of these holes can be accurately marked with a pencil point. Drawing lines through the dots and continuing them until they meet at a central point provides a graphic representation of the direction of the forces for incorporation in the students' record of the experiment. The apparatus is made entirely of metal finished in white nickel-plate and when folded up occupies but the small space of 74x6.5 cm. Each arm is 37 cm. long. Complete as illustrated, but without spring balances. **$3.00**



No. 714R.

714R. **Force Board.** As used in Millikan, Gale and Bishop's Course for composition of forces. Consists of a board, 50x75 cm., with cross strip at each end to prevent warping; and provided with three sets of nine holes for varying the position of the spring balances. With three metal pegs and metal ring, but without spring balances..... **$4.25**

Milvay Improved Force Table



No. 716R.

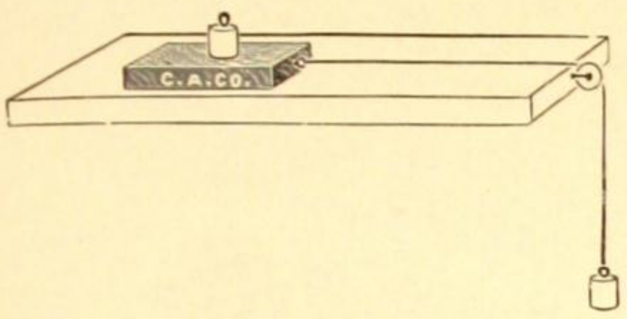
716R. Force Table, Milvay Improved Design With Aluminum Top and Protecting Rim. Unequaled for studying and demonstrating the laws of composition and resolution of forces, etc. The Milvay design offers a number of distinct advantages over others:

1. Protecting Rim. A plain smooth rim extends 2.5 cm. beyond and a trifle above the graduated scale. This provides a smooth sliding surface on which the pulleys may be moved from one position to another without marring or scratching the graduated surface. It, therefore, preserves the original high-grade appearance of this fine instrument. The design of this protecting rim is such that the position of the pulleys can be read with the same accuracy as in models where the graduations run out to the very edge.

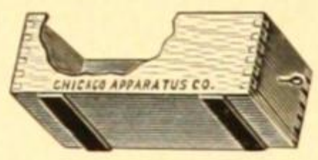
2. Increased Stability. The top is made of reinforced aluminum and supported on an extra heavy tripod base. This construction eliminates top heaviness and makes the apparatus far more stable than the older models.

The forces are produced by suspended weights. The cords pass over pulleys and are fastened to a ring, the movement of which is limited by an indicating pin in the center of the table. This prevents the cords from slipping off the pulleys when the forces are unbalanced. Adjustments of the magnitudes and directions of the forces are made until the ring is centered about the pin, the design of the pin being such that it affords the utmost ease in making these adjustments. The pulleys, provided with cone bearings, are practically free from friction. Each pulley is provided with an index line placed opposite the groove in the wheel, and it enables accurate reading of its angular position on the force table. The circle is divided into 360 degrees by 1 degree divisions, every 10 degrees being clearly marked by large figures. The diameter of the top is 45 cm. The vertical rod is 30 mm. in diameter, 45 cm. long, and finished in polished nickel plate. The tripod is extra heavy, finished in black enamel, and provided with three leveling screws. Complete with indicating pin, centering pin, four pulleys, four weight hangers, four each 50 and 100 gram slotted weights and two each 10 and 20 gram weights.....**$30.00**

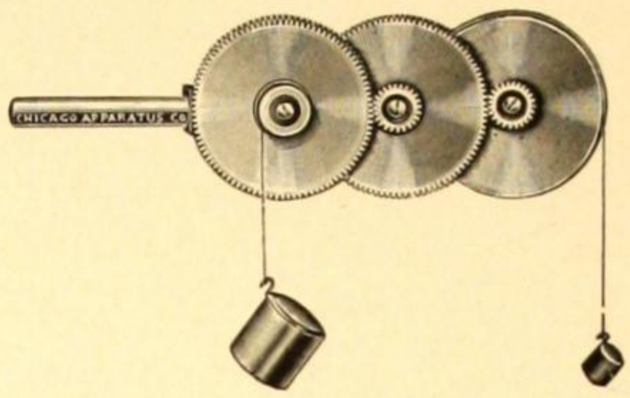
717R. Moments Apparatus, University of California Type. For use in connection with No. 716R Force Table in the study of non-concurrent forces. Consists of two drilled steel plates, three hardened steel balls, centering pin, and four metal pegs.....**$10.00**



Nos. 719R-720R.



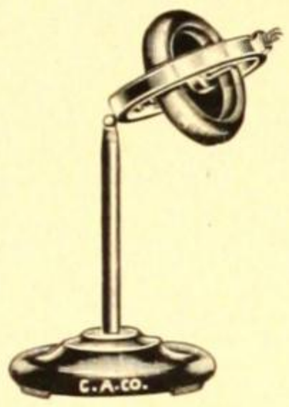
No. 722R.



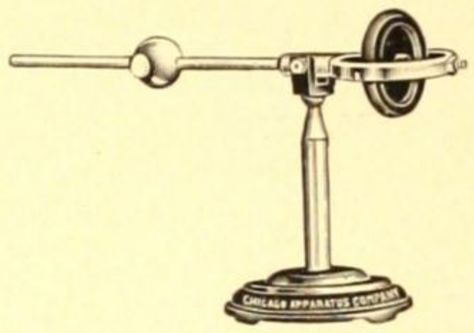
No. 724R.



No. 728R.



No. 729R.



No. 734R.

719R. **Friction Block.** Wood, smooth sandpapered surfaces, with hook. Size, 10x5x2 cm. Without board, pulley or weights.....**$0.35**

720R. **Friction Board.** Wood, smooth sandpapered surfaces. Size, 45x15 cm.; thickness, about 2 cm.**$0.50**

751R. **Pulley.** Bakelite pulley wheel, 4 cm. in diameter, in iron frame with slot, easily attached to any board. Runs freely in cone bearings. Screws for attaching included **$0.60**

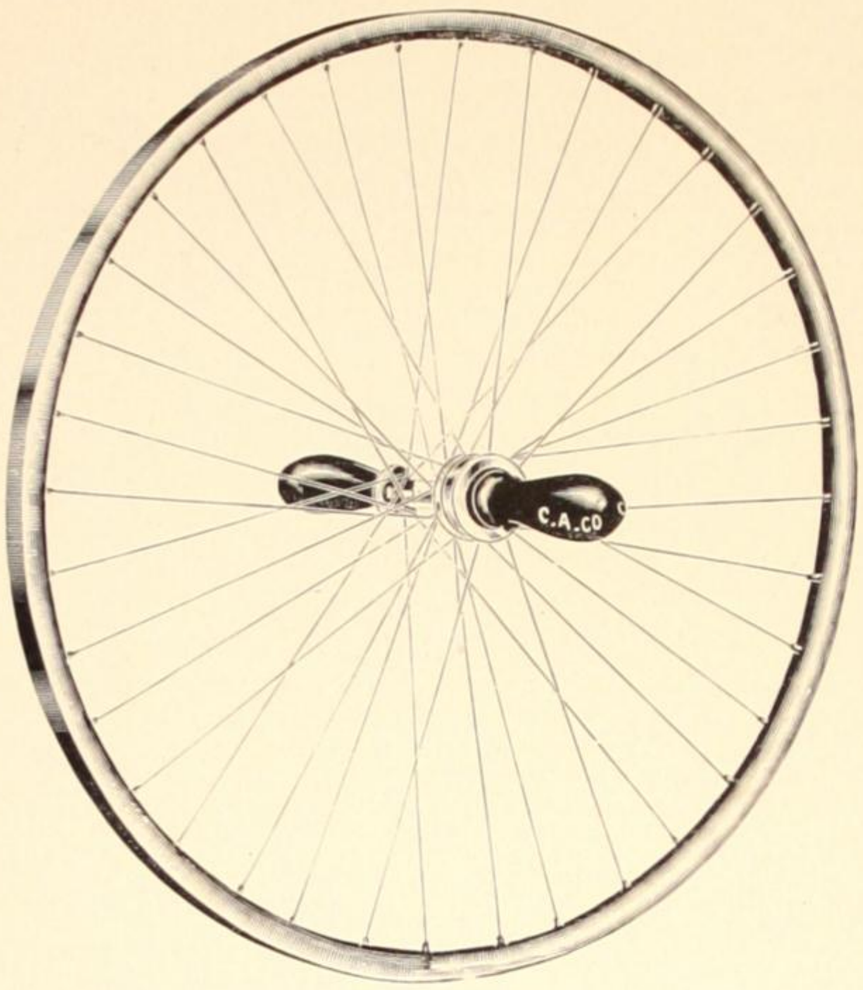
722R. **Friction Box, Gilley.** For determining the coefficient of sliding friction for leather on wood as outlined in experiment No. 7 in Black's "Laboratory Experiments in Practical Physics." The wooden box measures 15x7.5x5 cm. and has two leather strips glued to the bottom. Hook for attaching spring balance is also provided.....**$0.85**

724R. **Geared Wheels.** Consists of two disc gears and a drum, 7.5 cm. in diameter; and two pinions and a drum one-fourth the diameter, giving a mechanical advantage of 64. Mounted on a 13 mm. support rod. Made entirely of metal, neatly finished.....**$8.00**

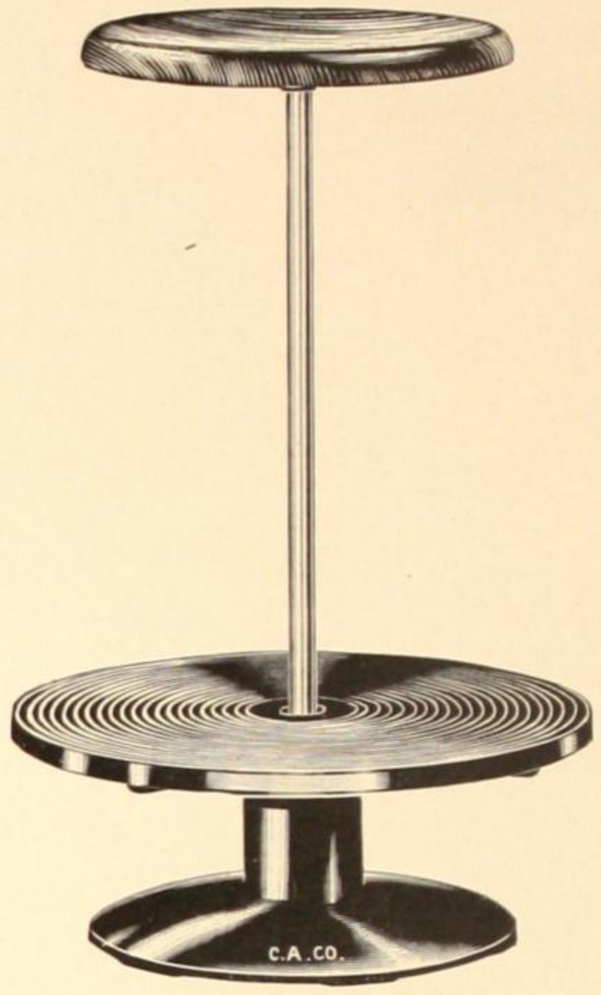
728R. **Gyroscope.** Simple form, 5.5 cm. diameter wheel, with stand.....**$0.75**

729R. **Gyroscope.** Extra heavy lathe turned wheel, 5 cm. diameter, accurately balanced and centered; with pivot and stand. A high-grade, well-made instrument—not a toy.....**$4.00**

734R. **Gyroscope, Lever Form, New Milvay Model.** Extra heavy lathe turned wheel, 7.5 cm. in diameter, accurately balanced and centered, with balance weight and lever, supported on finely finished metal stand. Length of gyroscope and lever arm, 30 cm. With this new model the phenomenon of precession can be demonstrated to advantage. This is due to the design and weight of the wheel and cannot be shown with smaller models having lighter and incorrectly designed wheels.....**$16.00**



No. 730R.



No. 731R.

730R. **Gyroscopic Wheel, 70 Cm. Diameter. Milvay.** This extra large gyroscope is of particular value from a teaching standpoint for several reasons. First: Its large size is attention compelling. Second: Its gyroscopic action, due to its great angular momentum, is so pronounced that it makes a deep and lasting impression on students privileged to manipulate it. Third: With it the fundamental properties of a body acting as a gyroscope can be demonstrated in a most convincing manner. Thus:

(1) Rigidity of Direction in Space or **Gyroscopic Inertia.** By holding the spinning wheel by both handles, with its axis in a horizontal position, its tendency to maintain the direction of its plane of rotation in space can be sensed by the great resistance offered to any effort to change it.

(2) **Precession.** When a force tends to alter the direction of the axle of a spinning gyroscope, the force meets with great resistance and the wheel will turn about an axis at right angles to the axis about which the force was applied. Thus, if the spinning wheel is suspended by one handle in the loop of a stout cord, the force of gravity acting at the center of the wheel will tend to alter the position of the axle in space, causing it to revolve about the cord as an axis. The rate of this motion, called precession, depends on the velocity of rotation of the wheel about its axis. By holding the spinning wheel downward at arm's length by one handle the great power of this precessional motion can be made to react on the muscular sense.

(3) A spinning gyroscope exerts an opposite reaction moment on the external agent tending to produce precession. Let the occupant of No. 731R Rotating Platform hold the spinning wheel by both handles with the plane of the wheel vertical and parallel to a radius of the platform. No movement of the platform will result. Now let him incline the wheel by raising one handle and lowering the other. The reaction will cause the platform with its occupant to revolve in a horizontal plane.

The wheel is a standard all-steel bicycle wheel, 70 cm. in diameter, provided with ball bearings, two large wooden handles and hub for receiving the cord for causing it to spin. The rim is fully and evenly loaded with lead, providing maximum mass at maximum distance from the axis. Hence, the wheel possesses tremendous angular momentum when spinning. And, it is this property that makes possible such striking demonstrations with this large gyroscopic wheel **$17.50**

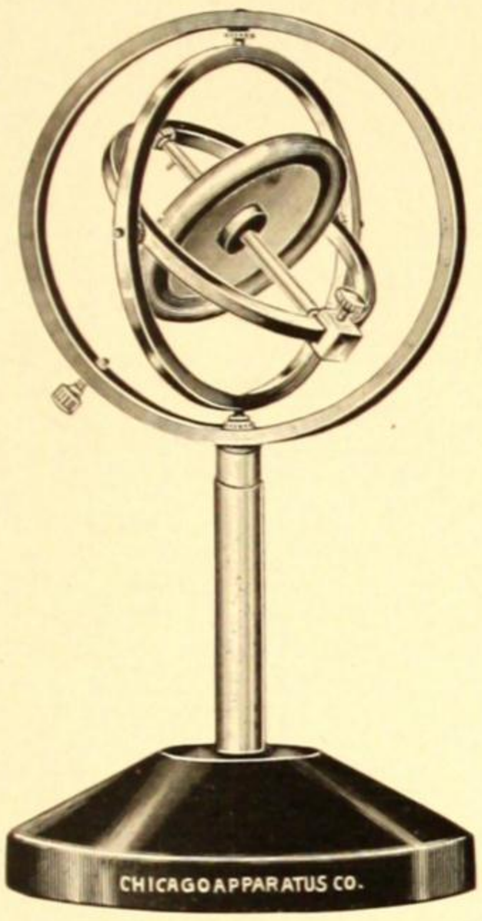
731R. **Rotating Platform or Stool.** This platform with its occupant represents for experimental purposes, a so-called isolated system capable only of rotary motion in a horizontal plane about its central axis. Being provided with the finest quality of ball thrust bearings it turns freely with very little friction. A person standing or seated on this platform may momentarily rotate the platform through a small angle by twisting the upper portion of his body, but as soon as he assumes his former position the platform will likewise return to its original position.

Should he hold over his head and rotate in a horizontal plane a long bar or stick loaded at the ends the platform will rotate under him as long as the motion of the bar is accelerated. As soon as the rotation of the bar is ceased, the platform, allowing for slight friction, will come to rest at its starting position. Try as he may, he finds that he cannot cause a permanent displacement, even through a small angle, without the application of an external force.

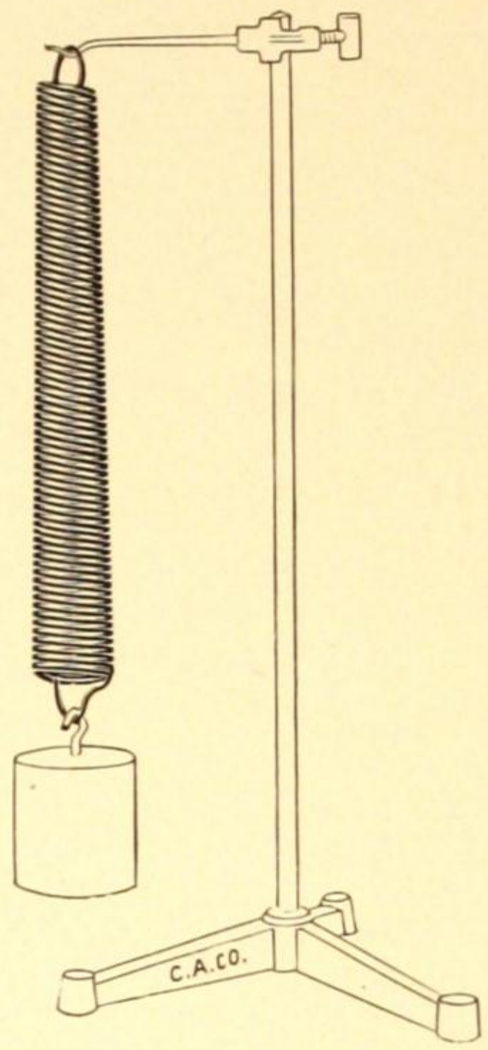
Another interesting experiment possible with this platform demonstrates the conservation of angular momentum in a most striking manner. Let the occupant hold a weight of say one kilo in each hand with his arms fully extended. While the platform is rotating have the occupant lower his arms, bringing the weights closer to the axis of rotation. A decided increase in the speed of rotation will be noted. By lowering the arms the moment of inertia of the system is reduced and the speed increased. By raising the arms, again, the moment of inertia is again increased and the rate of speed reduced, thus clearly showing the constancy of angular momentum.

If the occupant holds the spinning gyroscope No. 730R by both handles in a vertical plane parallel with a radius of the platform and then raises one handle while depressing the other, the platform will rotate under him. This rotation is caused by the reaction which the gyroscope exerts on the force of gravity which force in this case is external to the platform.

The platform is substantially constructed of iron, finished in black gloss enamel and is furnished complete with stool. **$30.00**



No. 735R.



No. 736R.

735R. **Gyroscope, Bohnenberger's.** Like the mariner's compass this gyroscope is provided with a double gimbal ring mounting; the outer ring, rigidly fixed in the stand, serving merely as the supporting frame. This type of mounting makes possible the demonstration of that important property of a body acting as a gyroscope—the maintenance of a fixed direction in space of the axis of rotation of such a body. This can be beautifully illustrated by spinning the wheel, then picking up the stand and turning the frame into every conceivable position. Regardless of how the frame is turned, the direction of the axis of rotation of the wheel remains unaltered.

Other important properties of gyroscopic bodies also may be demonstrated with this gyroscope. To illustrate precession, clamp the small weight to the inner ring, near one end of the axle. Set the wheel in motion so that the plane of spin will be in a vertical position. The axle will then revolve in a plane at right angles to the plane of spin, that is, in a horizontal plane. To demonstrate **precession** to the muscular sense of the student, first clamp the middle ring in a plane with the outer ring by means of the lock screw in the outer ring. Set the wheel in motion with the plane of spin in a vertical position, then let him pick up the stand and attempt to turn the axle of the wheel through an angle. The motion of the wheel will take place at right angles to the direction in which he is endeavoring to turn its axle.

To show **nutation**, clamp the small weight to the inner ring. The middle ring must not be locked to the outer ring in this experiment. Set the wheel in motion at not too high a speed and with the plane of spin in a vertical position. Give the inner ring a slight tap near the weight. Slight vertical oscillations or nutations in the form of small ellipses will then occur at the ends of the axis of spin.

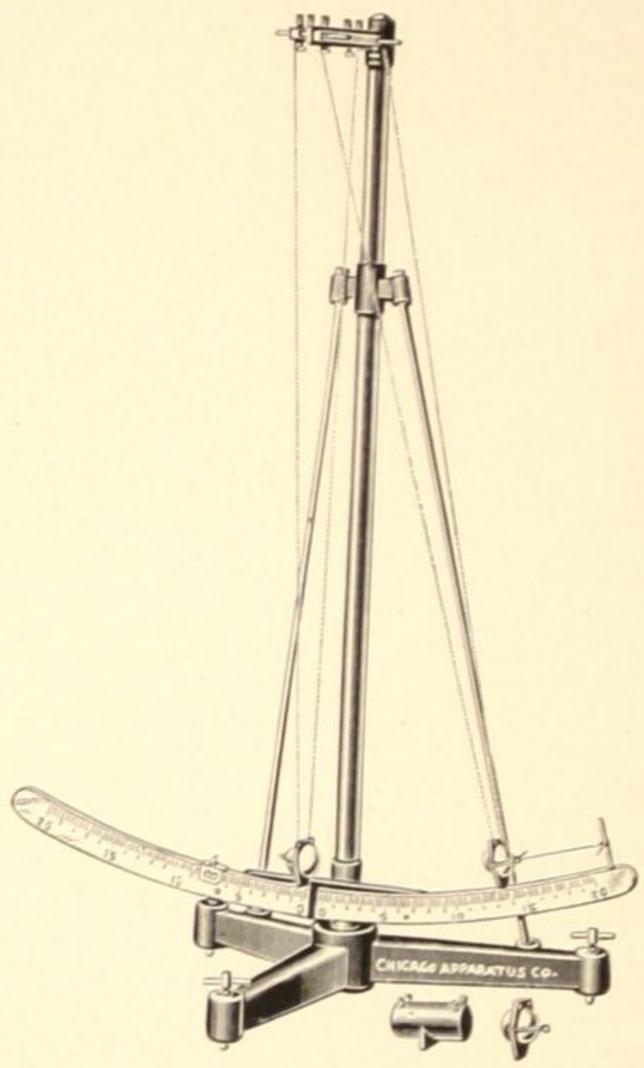
The wheel, 7.5 cm. in diameter, and rings are of brass, finely balanced and finished in polished nickel. The pivots are adjustable steel cones. The cast iron base is extra heavy, 15 cm. in diameter, and finished in non-chipping gloss black enamel. Overall height, 27 cm.

Complete, with precession weight and spinning cord **$30.00**

736R. **Spring, Large, Conical.** For use in the study of linear simple harmonic motion as outlined in Exp. 43, Minor's "Physical Measurements." Made of spring steel in the form of a truncated cone so that the stretch will be closely proportional to the load. Provided with suspension loop at the top and loading loop at the bottom. In use it is loaded from 550 to 1550 grams in steps of 100 grams, and for this purpose No. 321B Weight Hanger and No. 311B Slotted Weights will be found very convenient. No. 361B Universal Hook Weights are also excellent for this purpose **$2.00**

Milvay Impact Apparatus

New Design with Separable Arc



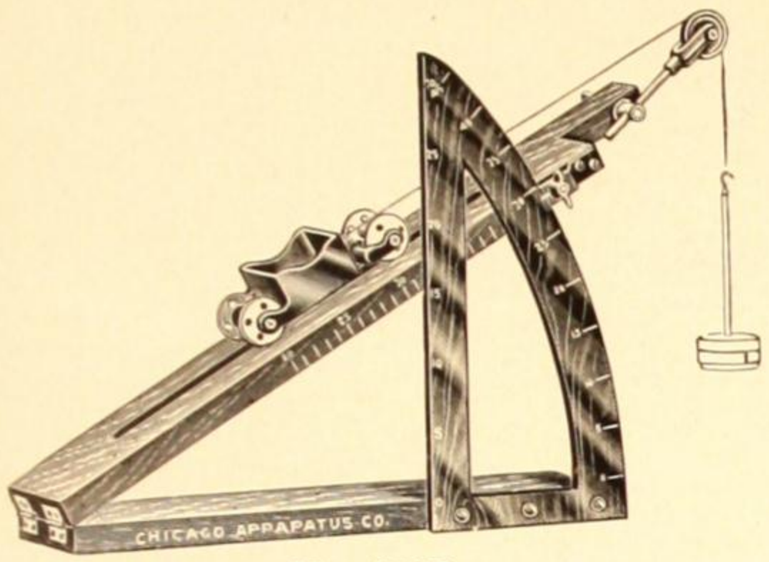
No. 737R.

737R. Impact Apparatus, Milvay. Separable Arc and Separable Suspension Head Type as used at University of Chicago. This improved form makes possible direct measurements. Mathematical calculations are unnecessary.

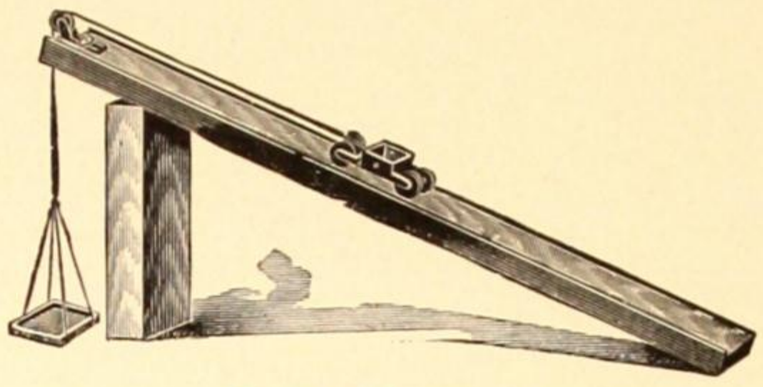
The graduated arc is made up of two segments. Each segment can be moved outward so that its zero point can be brought directly under the indicator of the impacting mass. In the old form, with a single segment arc, the indices of the impacting masses are always off zero. As a consequence the zero error must always be deducted to secure the correct result—an indirect method in which the danger of mistakes is always present. Great stability is essential in an apparatus of this kind. In the Milvay it is accomplished: First, by making the tripod much heavier than usual—actual weight 20.5 kilos; second, by employing a vertical rod 30 mm. in diameter; third, by bracing this rod in such a way that side sway is impossible. Suitable screws are provided for leveling the apparatus. The impacting masses furnished constitute the best assortment for the study of elastic and inelastic impact and consists of steel ball 50 mm. diameter, steel ball 47 mm. diameter, lead ball 50 mm. diameter, and lead filled cylinder 50 mm. diameter by 100 mm. long. All are arranged for bifilar suspension and provided with an index at their center of gravity. These indices also serve to move a light aluminum rider which slides freely along the arc and which accurately marks the extreme swing of the impacting mass. Each segment of the separable arc is graduated outward from 0 to 20 degrees in 12 minute divisions—5 divisions per degree. The mounting is such that each segment can be securely clamped in any desired position. The apparatus is approximately 170 cm. high and the workmanship and finish in every detail is strictly high-class **$60.00**

Inclined Planes and Cars

Inclined Planes, used in acceleration experiments are listed on page 293.



No. 739R.



No. 749R (in use).



No. 749R.



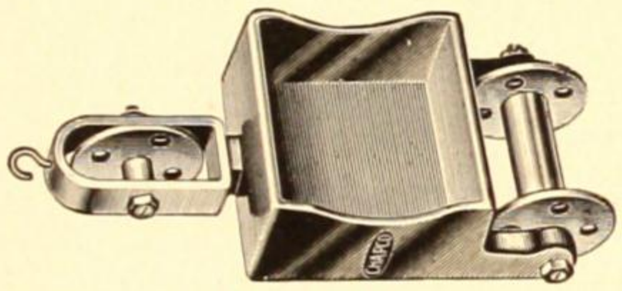
No. 751R.



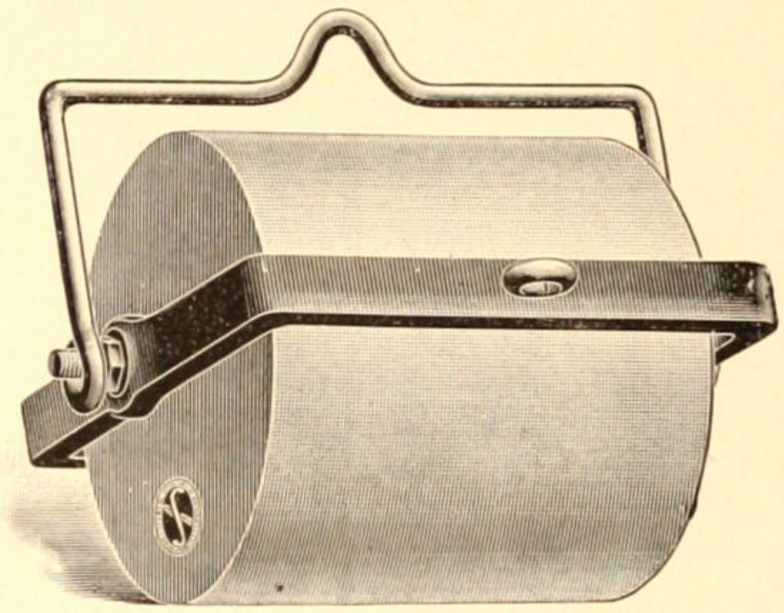
No. 759R.



No. 753R.



No. 760R.



No. 762R.

739R. Inclined Plane. Made of finely finished hardwood, with graduated arc, and freely running cone bearing pulley. The plane is 64x11.5 cm. The arc is graduated to 45° by 5° divisions. Graduations are also provided for determining the relative height and length of the plane. The plane is slotted so that forces parallel to the base as well as parallel to the plane may be studied. Without car and weights. **$7.50**

749R. Inclined Plane Board. As used in Millikan, Gale and Bishop's Course. Made of finely finished hardwood, 120x14 cm., and provided with No. 751R Pulley **$2.00**

750R. Inclined Plane Board. Same as No. 749R, but without pulley **$1.60**

751R. Pulley. Bakelite pulley wheel, 3.75 cm. in diameter; in iron frame with slot, easily attached to any board. Runs freely in cone bearings. Screws for attaching included **$0.60**

752R. Scale Pan. For use with No. 749R Inclined Plane Board. Japanned metal, 12x12 cm., with suspension cords **$0.30**

753R. Sonometer Attachment. As used in Millikan, Gale and Bishop's Course for converting No. 749R Inclined Plane Board into a sonometer. Consists of metal end plate with screws, wooden bridge and spool of No. 00 Piano Wire..... **$0.50**

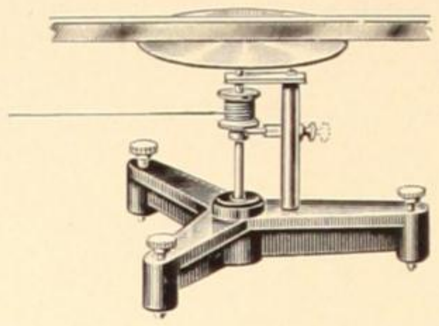
759R. Inclined Plane Car. (Hall's Car.) Improved construction, made entirely of metal, neatly finished, provided with hook for attaching cord. Lathe turned steel wheels, 35 mm. in diameter, mounted in cone bearing trucks to reduce friction to a minimum. One of the trucks is pivoted so all four wheels always bear on the plane. Inside dimensions, 5.5x5x3 cm. **$1.50**

760R. Inclined Plane Car. (Hall's Car.) Three-wheel type, for use with weights as weight in determining the mechanical advantage of the inclined plane. This car overcomes the error in the four-wheeled type, as three wheels insure positive wheel action on all wheels at all times. Japanned iron body, inside dimensions, 5.5x5x3 cm.; cone-bearing wheels of plated steel. Car is provided with hook for attaching power **$2.00**

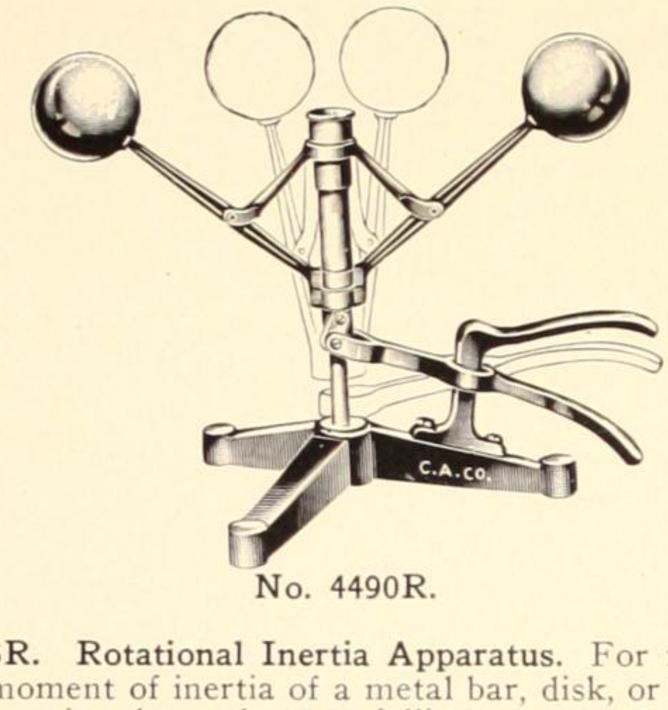
761R. Inclined Plane Roller, One-Pound. For use as a mass of known weight in inclined plane experiments. Cone-bearing roller—accurately turned and centered—mounted in a metal frame with hooks for attaching cord. The whole mass is adjusted to weigh exactly one pound **$2.50**

762R. Inclined Plane Roller, Six-Pound Pratt Institute Form. Accurately turned cone-bearing roller. Provided with two yokes, one for attaching the supporting cord and the other for attaching a spring balance for determining reaction normal to the plane. Roller measures about 3x3 inches. Weight, including yokes, exactly 6 pounds..... **$7.50**

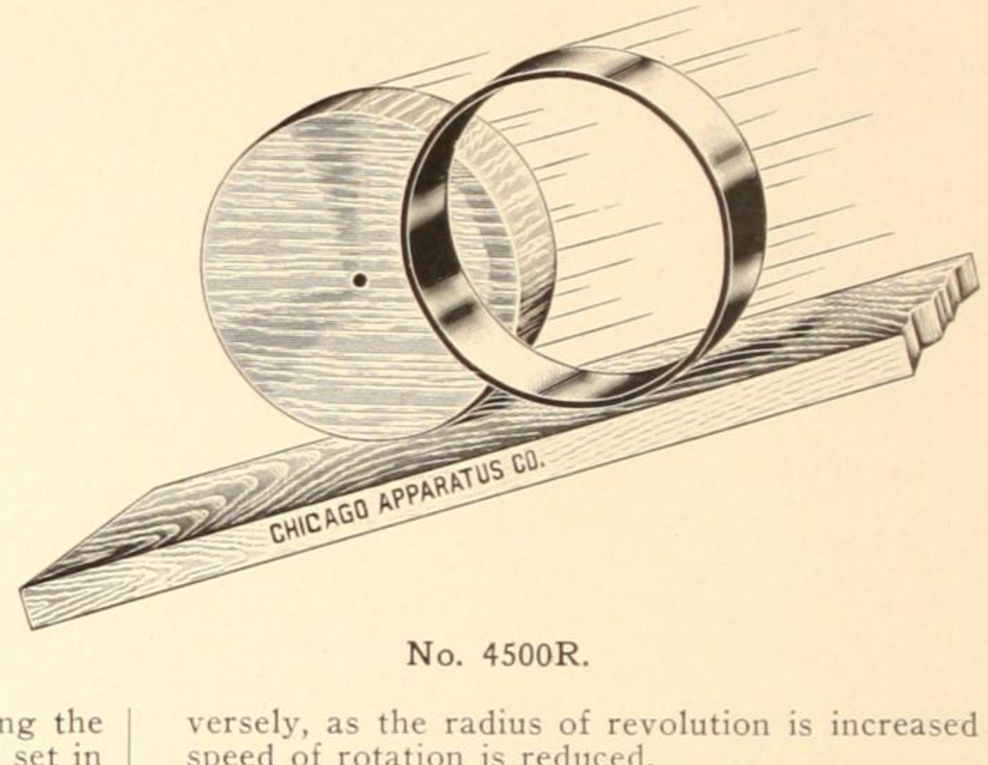
Inertia Apparatus



No. 763R.



No. 4490R.



No. 4500R.

763R. Rotational Inertia Apparatus. For finding the moment of inertia of a metal bar, disk, or ring set in rotation by a known falling mass as outlined in "Physics Laboratory Manual," by Schulz, and "Physical Measurements," by Minor. The kinetic energy of rotation is the difference between the potential energy of the suspended mass and its kinetic energy at the end of its drop. The angular velocity having been determined, the moment of inertia is calculated from the kinetic energy of rotation. The apparatus consists of a platform mounted on a vertical ball-bearing spindle to be used in connection with support, pulleys, weights and ring and disk of No. 455S Torsion Pendulum listed below. Rotating Ball-Bearing Platform only.....**$17.50**

Accessories for Use with No. 763R.

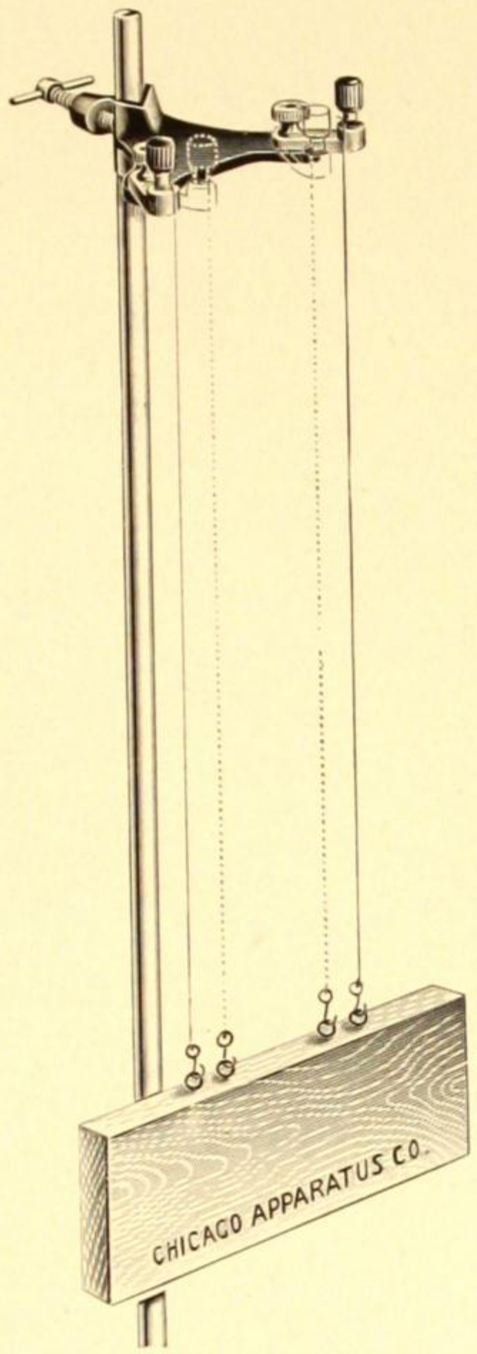
No. 85T. Table Clamp. One required.....**$2.65**
No. 155T. Support Rod, 100 cm. x 19 mm. One required **$1.35**
No. 66T. Right Angle Clamps, 19 mm. Two required. Each **$1.10**
No. 849R. Pulleys on Rod. Two required. **Each $1.00**
No. 321B. Weight Hanger. One required..... .40
No. 301B. Set of Weights. One set required... 3.00
No. 455S. Torsion Pendulum to provide metal disk and ring. One required.....**$27.00**

4490R. Momentum Demonstration Apparatus. For effectively demonstrating the conservation of angular momentum. In use, the spheres at maximum separation are set revolving at moderate speed. Then, as the handles are brought together, decreasing the distance between the spheres and thereby the radius of revolution, the speed of rotation increases. Conversely, as the radius of revolution is increased the speed of rotation is reduced.

The rotating system is mounted on specially designed ball bearings that make the device almost frictionless and once the spheres are set revolving they can be brought together and separated several times before they will cease to revolve. The spheres are 3 inches in diameter of polished aluminum and therefore visible to a large class. Other metal parts are finished in high-grade, dark-green enamel. The apparatus is 36 cm. high with an extreme rotating diameter of 43 cm.

For the visual demonstration of the preservation of the constancy of angular momentum Iw this device is unexcelled and we can highly recommend it for the teaching of dynamics in courses of Physics, Astronomy, Mathematics, Mechanics or Engineering **$40.00**

4500R. Moment of Inertia Demonstration Apparatus. Milvay. For showing that two bodies, free to roll and having different moments of inertia, will undergo different rates of angular acceleration when acted upon by the same force, which in the case of an inclined plane is the force of gravity. Consists of a solid hardwood cylinder and a hollow brass cylinder alike in external dimensions (6x2 inches) and mass. In one the mass is distributed uniformly at all distances from the geometrical axis, in the other at practically one distance. Based on the formulas which apply in such cases, $I = \frac{1}{2} Ma^2$ and $I = Ma^2$, the moment of inertia of the solid cylinder is about one-half that of the hollow cylinder. Consequently, when both are placed side by side on an inclined surface and released at the same instant, the wooden cylinder, because of its smaller moment of inertia, will roll down faster than the brass cylinder.....**$4.00**



No. 4510R.

4510R. Radius of Gyration Apparatus. For use in determining "k" for a block with bifilar suspension oscillating about a vertical axis, as outlined in R. S. Minor's "Physical Measurements, Part 1, Heat, Mechanics and Properties of Matter."

In use, the block of accurate geometrical shape is suspended from two equal parallel strings about one meter long and 11 cm. apart. After the suspensions have been accurately adjusted, as to length and parallelism, the block is set oscillating about a vertical axis through its center with an amplitude of not more than ten degrees and the periodic time determined with an accuracy of one part in 200. The length of the strings and the distance between them is then carefully measured. The period T, of a body whose radius of gyration is k, oscillating on a bifilar suspension of length 1, and distance 2b between the strings is

$$T = 2\pi\sqrt{lk^2 \div gb^2}$$

Hence

$$k^2 = \frac{T^2\, g\, b^2}{4\,\pi^2\, 1}$$

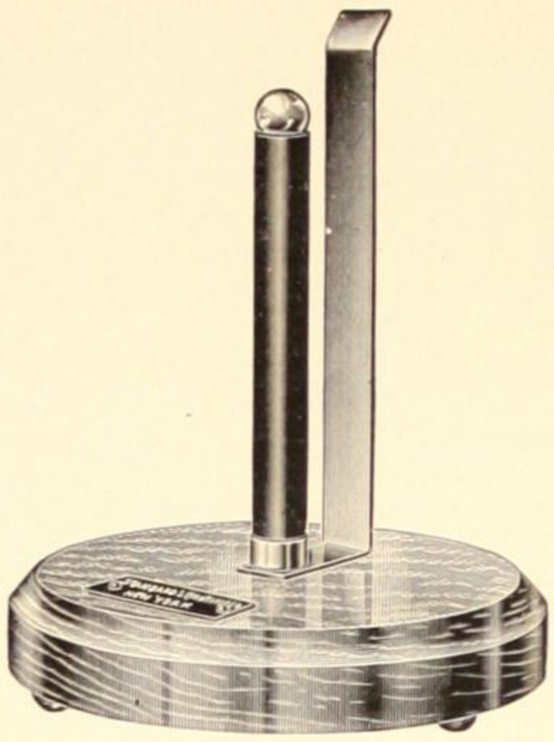
consequently, by determining the value of T, g, b and l, the value of k can be calculated. Further, the radius of gyration of a rectangular block in terms of its length and width is

$$k^2 = \frac{L^2 + W^2}{12}$$

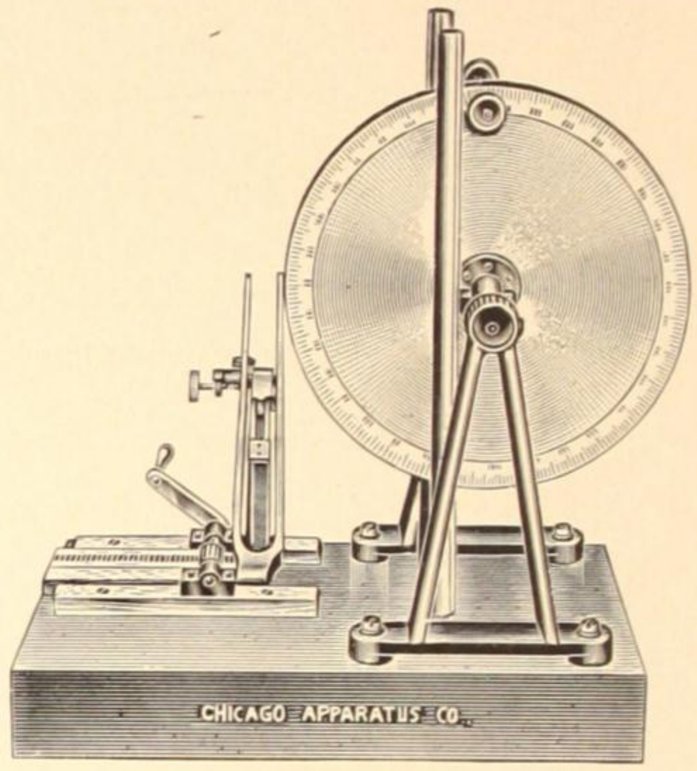
where L is the length and W the width. By calculating the value of k by using the foregoing equation, the accuracy of the results obtained experimentally can be compared.

It is worth noting that in our design of this simple, yet instructive apparatus but two suspensions and two keys for adjusting their length are employed instead of the customary four. This simplification is due to the fact that the suspension arms are adjustable in a horizontal plane and can be set any distance apart from 5 to 11 cm. This adjustable arm feature not only provides the means for securing true parallelism of the strings but also permits the use of improvised blocks with suspension eyes placed different distances apart. The plate carrying the suspension arms is provided with clamp fitting 19 mm. diameter rods or less. The block is provided with two sets of suspension eyes approximately 7 and 11 cm. apart.

As illustrated, but without support rod.....**$6.00**



No. 764R.



No. 765R.

764R. Inertia Apparatus. For illustrating inertia. Consists of a metal stand, about 12.5 cm. high, with concave top, spring, cord and ball. When the cord is given a sudden blow with the spring it is knocked from under the ball, the ball gains no horizontal momentum, but drops into the concave cup at the top of the stand.....**$1.25**

610R. Inertia Ball. Diameter, 3 inches; cast iron, japanned; provided with three metal suspension loops, two diametrically opposite to each other, the third at right angles to the other two.....**$1.15**

765R. Inertia Apparatus, Rotational, Milvay. Our present design is a distinct improvement over earlier models and as a consequence the apparatus is easier to manipulate and yields more accurate results.

The Disc and Shaft, made of rolled brass, are of uniform density. The satin nickel plate finish makes an ideal tracing surface and, when coated with lamp black, makes the tracings stand out in bold relief. Being mounted in cone bearings instead of ball bearings as in the older models, the disc and shaft can be easily and quickly removed. The entire unit is accurately machined and the shaft being of cylindrical form without roller bearing attachments as in the older models, makes it very easy to measure these parts accurately. One face of disc is graduated in ½ degrees; the other is smooth for receiving the tracings. Weight of disc and shaft about 4.5 kilos. Disc measures about 16x200 mm., shaft about 25x 160 mm.

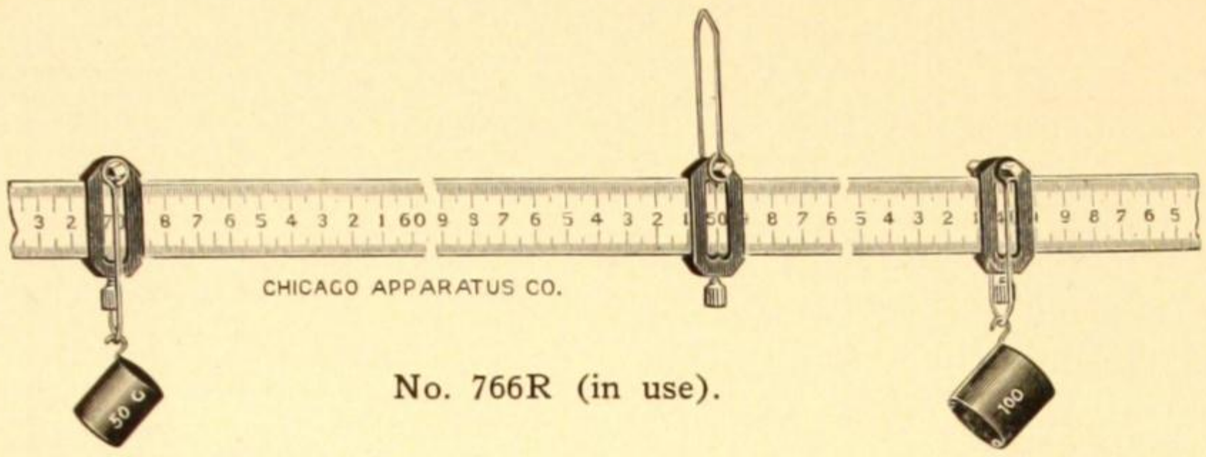
The **Tuning Fork,** electrically driven, is accurately rated, frequency about 130 V. P. S., and has steel stylus attached. The operating mechanism is so designed that during operation the stylus is automatically brought into contact with the edge of the disc and after having made its complete tracing again automatically moves away from the disc at a point near the shaft. The result is a beautifully clear-cut sine-wave tracing unmarred by scratches. The fork mounting and operating mechanism constitute one detachable unit.

Two Magnifiers are furnished, one for counting vibrations and locating points thereon, the other for reading angular positions. Both are adjustable for focusing and are mounted on square rods to limit their motion along the radius of the disc.

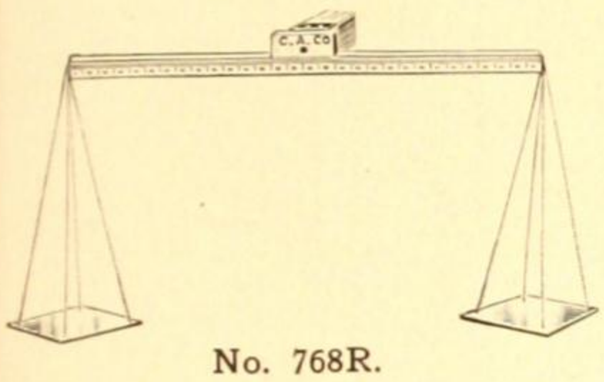
The **Base** is of cast iron extra heavy to insure stability and handsomely finished in black enamel. The workmanship and finish of this instrument is strictly high-class **$50.00**



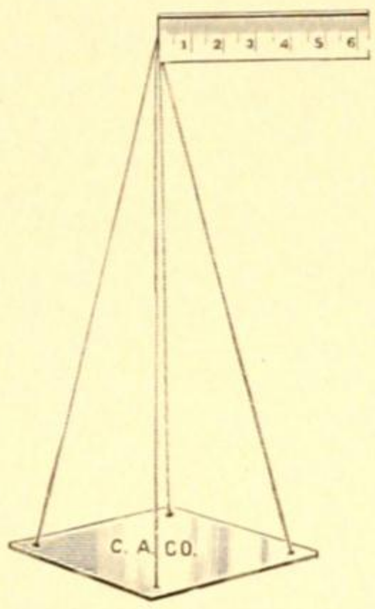
No. 766R.



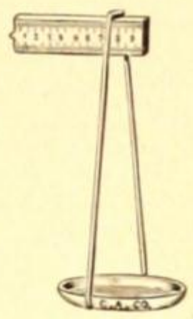
No. 766R (in use).



No. 768R.



No. 774R.



No. 779R.

No. 784R.

766R. Lever Holder. Improved form. Unequaled for demonstrating the principle of the balance, laws of lever, etc. Made to fit a standard meter stick. Provided with heavy steel knife edges, metal suspension loop, large set-screw for clamping the holder to the meter stick, and an indicator which allows the exact position of the knife edges to be read without difficulty. Three of these Lever Holders, one set of No. 352B Weights and one No. 358M Meter Stick make an excellent combination for the study of Levers and Moments ..... **Each $0.25**

768R. Lever and Support Bar. For use in the study of mechanical advantage of the lever. Consists of a wooden support bar to which is attached a lever 30 cm. long, graduated in millimeters, complete, but without pans **$0.85**

769R. Lever Rider Block. As used in Hall and Bergen's Course. Wood, slotted to slide on meter stick, for use in determining weight of lever arms **$0.25**

771R. Lever Rider Weight. Piece of lead 1 inch wide for attachment to meter stick used in lever experiments. See Experiment No. 4, Black's "Laboratory Experiments in Practical Physics" **$0.50**

774R. Lever Scale Pans. For use with No. 768R. Brass, 6.5 cm. square, with attached suspension cords, each adjusted to 1 ounce ..... **Per pair $0.75**

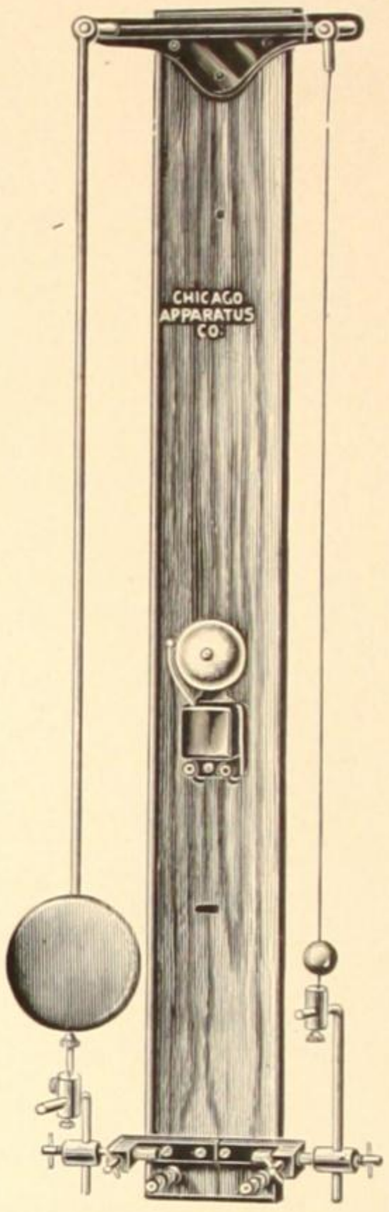
776R. U-Shaped Wire Stirrups With Hooks. For more conveniently suspending No. 774R Scale Pans from No. 768R Lever. The U-shaped portion fits over the lever arms of No. 768R, while the hook engages the suspension cords of No. 774R Scale Pans ..... **Per Pair $0.10**

779R. Lever Scale Pans. With improved knife edge bearings. For use in lever experiments. Circular brass pan 8.5 cm. diameter; attached to brass wire stirrup 19 cm. long, provided with knife edge bearing ..... **Per pair $1.00**

784R. Momentum Apparatus. With Metal Suspensions. Improved form. In this new form the string suspensions have been replaced by metal suspensions. They allow a quicker and more accurate adjustment. The wood balls have a weight ratio of 1 to 2. The larger ball is provided with a hammer and spring held under compression by a thread. The force developed on releasing the spring—by burning the thread—acts and reacts on both balls, imparting to the smaller ball twice the velocity of the larger. The momentum acquired by each ball is equal, and opposite, thus effectively illustrating Newton's third law. Mounted on heavy japanned iron tripod with 90 cm. nickel-plated rod. Complete with graduated arc **$20.00**



No. 473M.



No. 796R.



No. 794R.



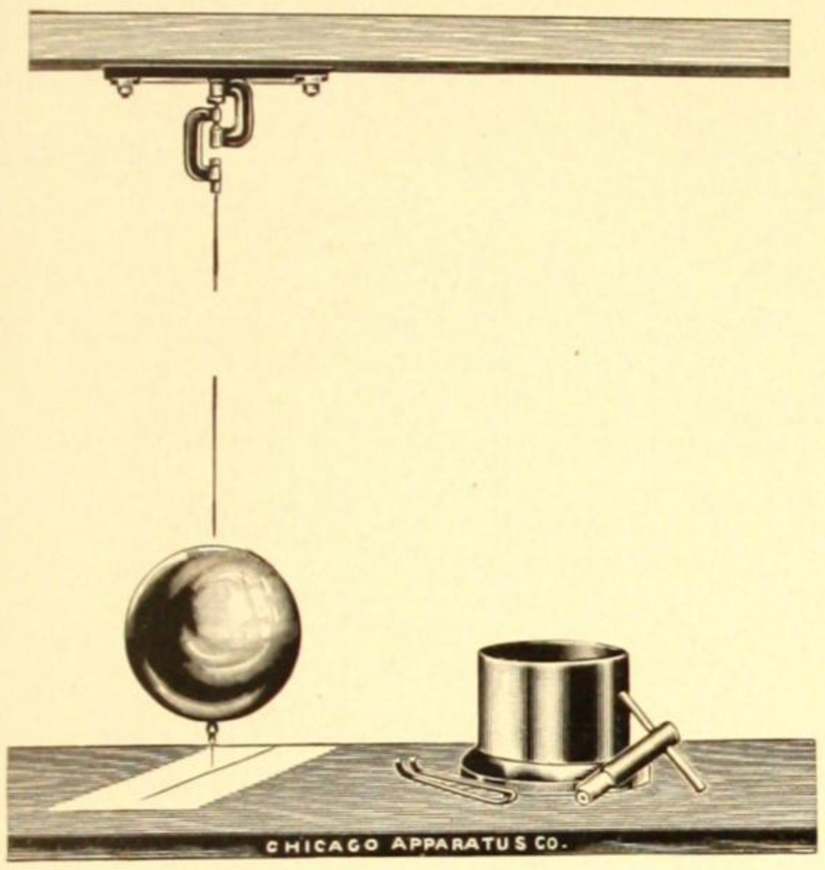
No. 795R.

794R. Pendulum Clamp. New model. Grips and holds the finest thread as securely as a heavy cord. Slipping is impossible. Edges of clips match perfectly. This gives exact points of suspensions and makes it easy to determine exact lengths of pendulums. Upon turning the thumb-screws the vise-like clips open automatically. The insertion of suspensions and adjustments as to length can therefore be accomplished with utmost ease. Has none of the disadvantages of other makes—no loose plates to slip out of their guide pins—no indefinite points of suspension. Can be used on any vertical or horizontal support rod 19 mm. or less in diameter. Clamp and arm are of iron—black enameled; clips and thumb-screws are finished in white nickel-plate..... **$1.00**

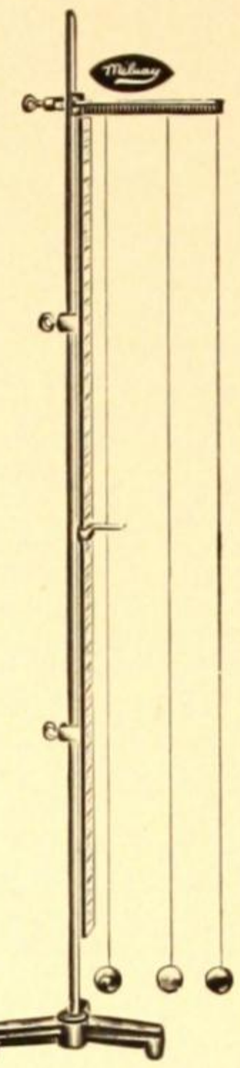
795R. Pendulum Clamp, of Wood. Jaws are held together by two brass thumb-screws. Total length, 30 cm. **$0.45**

473M. Seconds Pendulum. An inexpensive substitute for a laboratory clock. Consists of a lens-shaped iron bob 15 cm. in diameter, adjustably mounted on a metal rod. This rod is supported at its upper end on a knife edge, its lower end is provided with an adjustable contact tip. Mounted on a finely finished 15x120 cm. hardwood back provided with an improved adjustable mercury well which produces a thin edge of mercury giving a sharp contact. The wood back is also provided with binding posts for attaching battery and sounder to beat seconds audibly. This pendulum can be readily adjusted, by slightly raising or lowering the bob, to beat seconds very accurately **$12.50**

796R. Pendulum, Coincidence. For determining the value of "g" by the method of coincidence. A second's pendulum and a simple pendulum mounted on one support, each being provided with an adjustable mercury cup. The pendulum and cups are so connected in circuit with a single stroke electric bell that the circuit is closed only when both pendulums strike the mercury cups at the same instant. By setting both pendulums in vibration and noting the interval between two coincidents, the period of the simple-pendulum can be obtained when that of the other is known. The length of the simple pendulum may easily be measured by use of a meter stick or cathetometer, and the value of "g" therefore readily determined **$27.50**



No. 798R.



No. 800R.

798R. Foucault Pendulum, 14.5 Kilo. A massive pendulum, especially designed for the clear, effective demonstration of the Earth's rotation and for the study of the pendulum.

The support bearing is a hardened steel cup held in a bronze yoke which screws into a steel plate that fastens to the ceiling. The pivot bearing is a hardened steel pivot so held in a movable yoke that its upper end extends through the yoke into the safety recess.

The safety recess is a special inverted cup-like receptacle with a deep outer ring over the pivot pin. It receives the extension of the top of the pivot and while allowing it to swing freely, prevents the pivot yoke from dropping from the support bearing when the pendulum weight is removed.

Special locking blocks attached to the ends of the support wire prevent it from slipping or breaking. Their use distributes the weight of the ball along the loop of wire encircling the block, thus eliminating any heavy breaking strain at one point. Also, as the weight is held by the block, there is no opportunity for the wire to slip. The wire at the upper end passes through a hole in the end of the yoke under the pivot and then loops around the locking block which rests on the yoke. At the lower end the wire passes through the hole in the plug and then around the block. This block pulls up against the plug and gives a rigid support for the ball when the plug is screwed in place.

The support wire, of which 100 feet is supplied, is a high carbon wire of great tensile strength, so that a wire of very small diameter, with correspondingly slight air resistance, will carry the weight of the ball.

The pendulum bob, about 14 cm. diameter and weighing 14.5 kilos, is a steel sphere accurately turned to size. Steel is used to assure a homogeneous mass not easily distorted by accidents. Its smooth lacquered surface offers minimum air resistance. On top of the ball is a threaded hole into which the drilled brass plug for the supporting wire is screwed. Diametrically opposite to this plug is a smaller hole into which is screwed the brass bushing carrying the steel stylus.

The stylus is a steel needle held in a brass bushing that screws into the underside of the ball. Should the stylus become broken through accident, it is a simple matter to remove the bushing, replace the needle and reassemble it in the ball.

A carrying handle is provided which replaces the plug in the top of the bob and makes it easy to handle the ball for storage or transport. A storage support for the ball (shown in the cut) and special wrenches are also supplied. **$40.00**

799R. Pendulum Illustration. For verifying the laws of the pendulum. Consists of a heavy japanned iron tripod base, 12 mm. x 110 cm. nickel-plated support rod, No. 794R Metal Pendulum Clamp, two 1-inch cast iron balls and one 1-inch wood ball and suspension cords **$4.00**

800R. Pendulum Illustration, Improved Form. Consists of a 799R Pendulum Illustration with the addition of an Adjustable Pendulum Attachment consisting of a 100 cm. meter stick provided with clamps for attaching to the support rod, and a slide which can easily be set at any desired point on the scale. This slide is provided with a narrow slot through which the pendulum cord passes, and which acts as a point of suspension for the pendulum. The zero of the meter stick is placed at the bottom and when the pendulum has once been adjusted so that the center of the bob is opposite this point, the length of the pendulum may be read directly from the position of the slider. This attachment will prove valuable in any physical laboratory, as it enables a maximum number of readings to be taken in a given time **$7.50**



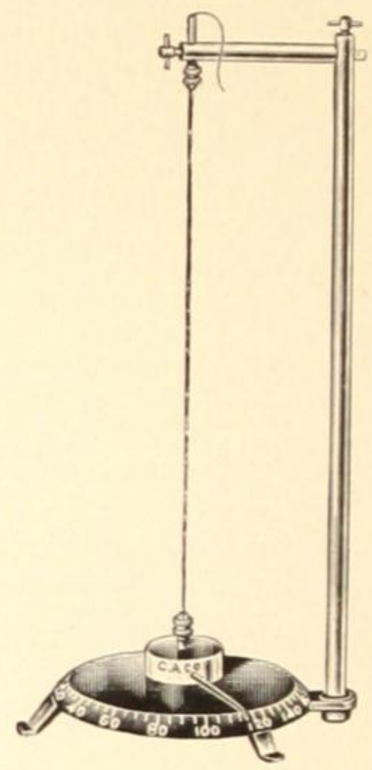
No. 802R.



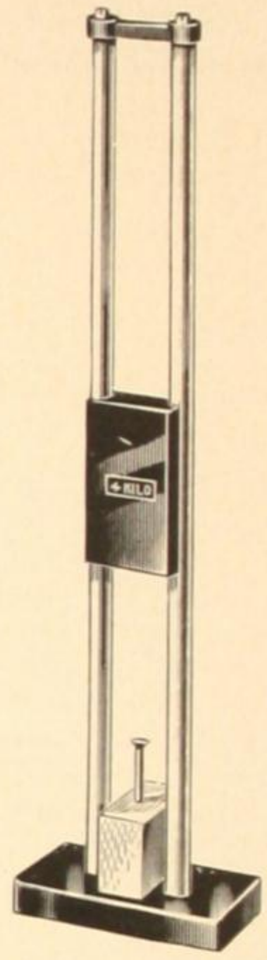
No. 804R.



No. 814R.



No. 809R.



No. 810R.

802R. Pendulum, Kater's Bar. For finding the length of the equivalent of the second's pendulum and the value of "g." The rod, made of steel, measures 60x2.5 cm. and is provided with two hardened steel knife edges, coincidence mirror, wall support, and clamp for simple pendulum. A very serviceable pendulum for student's use and laboratory experiments—unbreakable, durable and accurate. All necessary adjustments can be made with a screwdriver **$7.50**

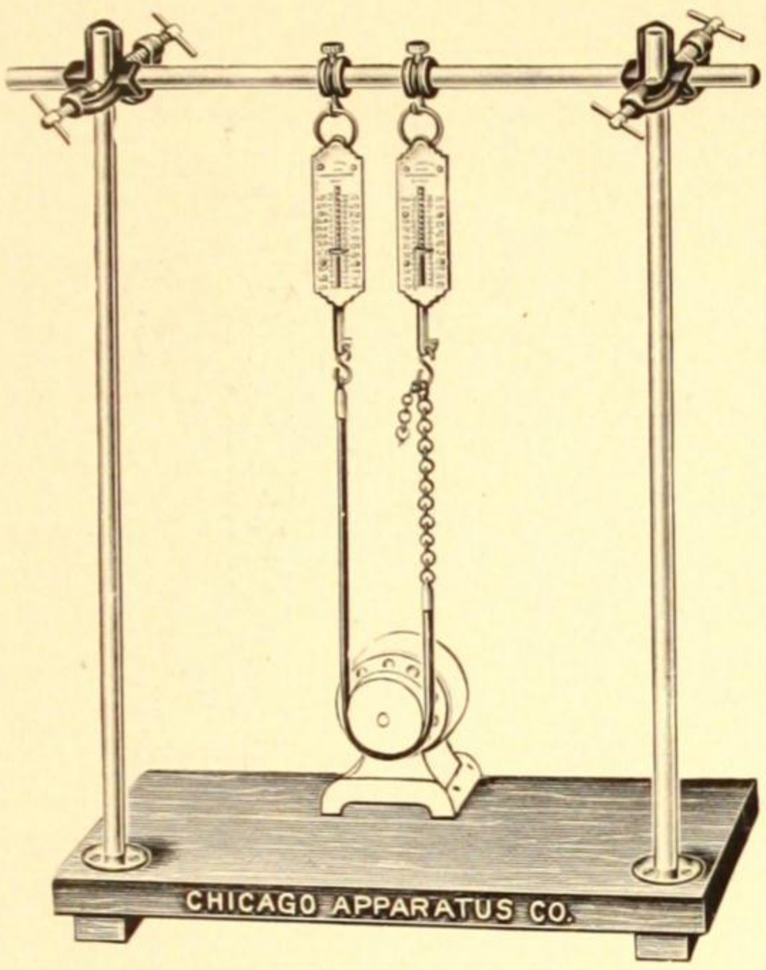
804R. Pendulum, Sand. An iron funnel, dead black finish, 7.5 cm. in diameter, suspended by two cords, and an adjustable slider. When the cords are suspended from two separate points, the funnel filled with fine sand, the slider on the cords adjusted, and the funnel set in motion it will trace, by a path of sand, a figure which is the resultant of two harmonic motions **$1.00**

Pendulums, Seconds—See page 257.

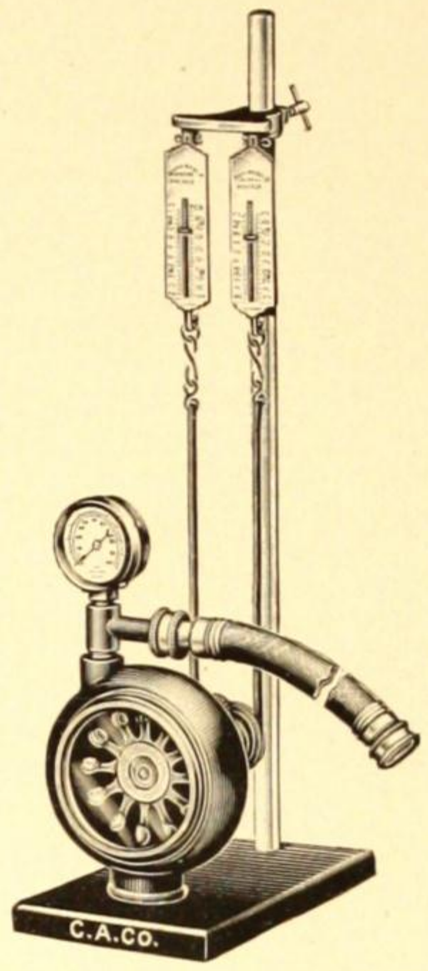
814R. Plumb Bob. Iron, weight 10 ounces..... **.20**

809R. Pendulum, Torsion. For measuring the moment of inertia of a body suspended at the end of a wire by observing the period of the rotational oscillation. The steel wire is firmly held in two special spring jaw chucks so designed that they cannot injure or mar the suspension. The iron base, finished in black enamel, is 24 cm. in diameter and graduated for 180° each side of zero in 5° divisions. The heavy metal disc weight is 65 mm. in diameter and provided with an aluminum pointer. Overall height, 65 cm. **$8.50**

810R. Pile Driver, Milvay Experimental. For the laboratory determination of the work done by a pile driver as outlined in experiment No. 26 in N. Henry Black's Manual, "Laboratory Experiments in Practical Physics." This experiment is based on a similar one used by Dr. E. R. Schaeffer of Harvard University and Prof. Wm. S. Franklin of the Massachusetts Institute of Technology. A nail is substituted for the pile and a pine block for the earth. The grooved 4-kilo hammer, sliding between vertical steel guide rods, can be made to drop any distance up to one meter. The distance can be readily measured with a meter stick. By tabulating the total fall of the hammer, the height of the nail above the block, the distance it is driven in by each blow, and the total distance it is driven in, it is possible to calculate the potential and kinetic energy of the hammer and the resisting force of block. Plotting the resisting force against the depth of the nail will reveal how the resistance increases as the nail sinks into the block. By substituting blocks of oak, maple, spruce, etc., a comparative study of the resisting force of various woods may be made..... **$11.50**



Nos. 815R-816R.



No. 817R.

815R. Prony Brake Apparatus. (Modified form of Prony Brake.) For making power and efficiency tests of small size electric motors having grooved belt wheel or pulley as outlined in Experiment No. 49 of Millikan, Gale & Davis' "Exercises in Laboratory Physics," and similar experiments in other manuals and texts. Consists of a cross rod adjustably clamped to uprights 60 cm. high, provided with hook collars from which two 64 oz.-2000 gram capacity spring balances and brake belt with link-chain adjustment are suspended. The rods and base plates are finely finished in polished nickel-plate and are mounted on a 45x20 cm. mahoganized wooden base to which the motor can be readily bolted or clamped. With this simple apparatus it is very easy to determine the motor output in foot-pounds per minute, which result can be expressed in horsepower by dividing by 33,000.

The input can be measured by either the voltmeter-ammeter method, or by the watt-meter method. The ratio of output to input indicates the efficiency of the motor. Since both brake-horsepower and efficiency tests are frequently made in industrial plants, the experiment with this apparatus is of unusual vocational value.

Our No. 2715E Universal 110-volt motor, or any other small motor with a horsepower of 1/20th or less, is suitable for use with this apparatus. Complete as illustrated, but without motor.....**$18.50**

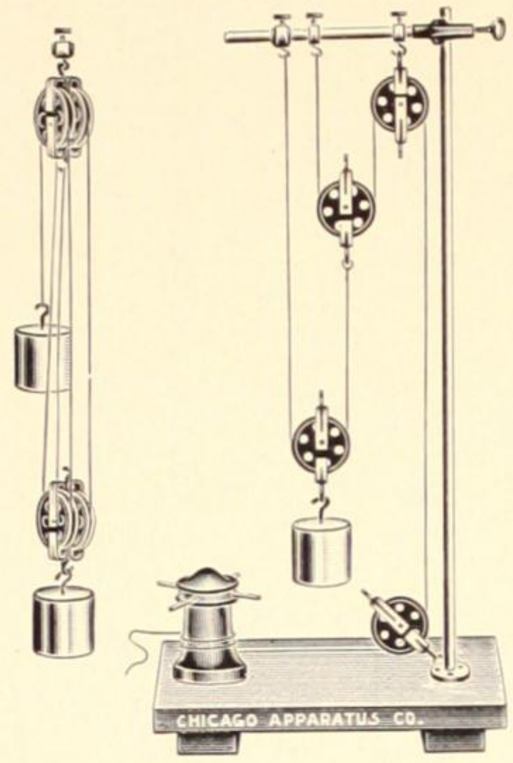
816R. Prony Brake Apparatus. Same as No. 815R, but fitted with balances reading up to 30 pounds—15 kilos. This apparatus is suitable for testing motors from ⅛ to ½ horsepower.....**$27.50**

735Ed. Extra Prony Brake Belt. For Nos. 815R or 816R, for replacement. Of $\frac{3}{16}$-inch belting, 27.5 inches overall length.....**$0.60**

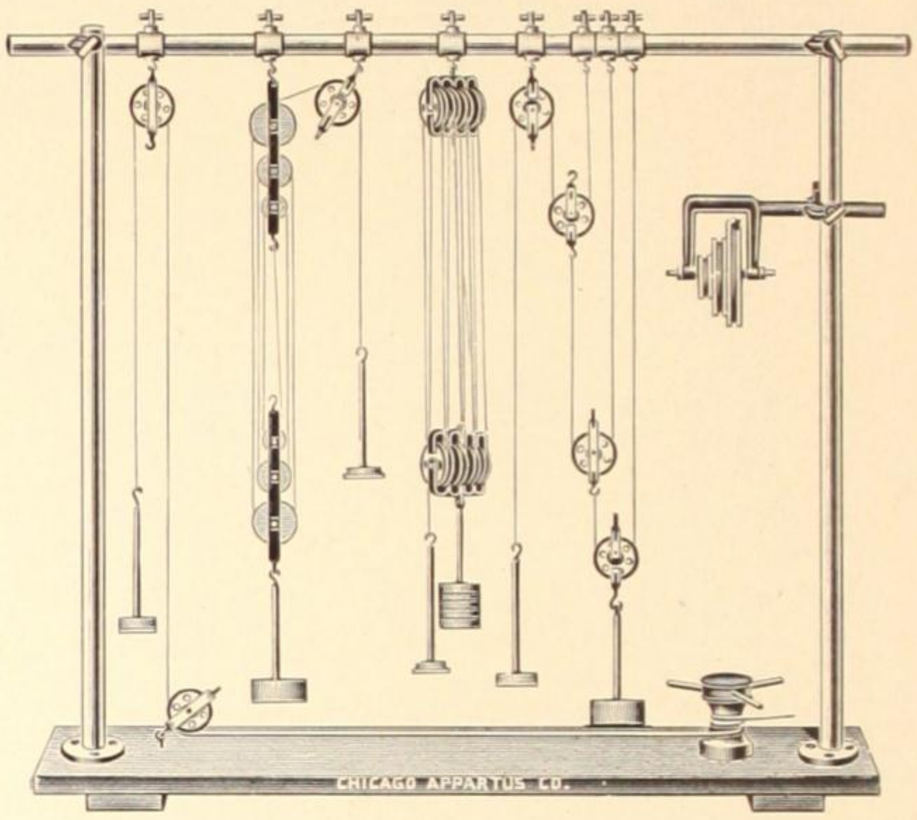
817R. Prony Brake Apparatus, Water Motor Type, Milvay. For measuring the horsepower and efficiency of a water motor as outlined in Experiment No. 5, Millikan's "Molecular Physics and Heat." The motor is of the glass-front demonstration form, 15 cm. diameter, with a Pelton-type wheel. It is mounted on a metal base, 15x25 cm., having a discharge opening in it and provided with a rod and clamp for adjusting the spring balances. A revolution counter with finger-spring mounting provides a simple and convenient means for determining the speed. The pressure of water gauge reads up to 50 lbs. in 1-lb. divisions; the spring balances up to 2000 grams in 25-gram divisions. The grooved pulley is 5 cm. in diameter and the round belt ⅜ inch in diameter. The hose is a 3-foot section of standard garden hose with couplings for connecting to a threaded faucet. The inlet at the motor can be replaced with another (attached to base when not in use) for connecting to a smooth laboratory-type faucet by means of ⅜ inch bore rubber tubing. The Milvay offers a new and simpler design of this popular apparatus. It is easier to use, more convenient, and because of the finer motor employed yields finer results. Complete as illustrated **$45.00**

818R. Prony Brake Belt. For No. 817R, for replacement. Of $\frac{3}{16}$ inch round belting, with hook at both ends. Overall length, 22.5 inches.....**$0.60**

Milvay Bakelite Pulley Illustrations



No. 819R.



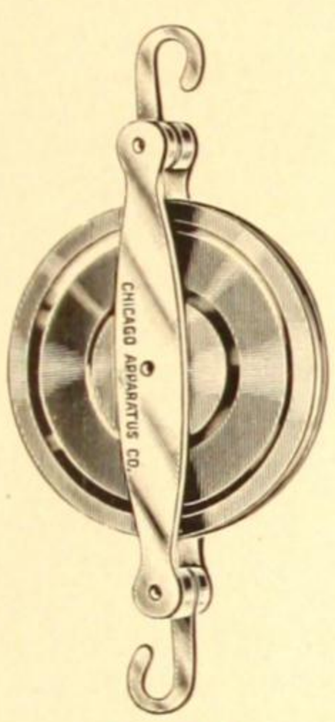
No. 821R.

819R. Pulleys, Illustration of, Milvay Bakelite. Offers three distinct advantages over older types with hardwood pillar permanently attached to base and with hooks permanently fixed in cross arm: First, the support can be used to good advantage in other experiments. Second, the Upright Rod is removable—an advantage in storing the apparatus. Third, the Hooks are adjustable along the cross-bar. This construction makes it possible to keep the Suspension Cords in proper alignment regardless of what combination or arrangement of pulleys is used. The outfit consists of a neatly finished Hardwood Base, with Threaded Sockets, a nickel-plated steel Support Rod 19 mm. by 60 cm., cross-bar with three Hook Collars, 5 No. 831R Single Bakelite Pulleys, 2 No. 832R Double Bakelite Pulleys, 1 No. 1024R Wheel and Axle, 1 Capstan, 25 yards of Pulley Cord, and a Complete Set of Nine Solid Brass Universal Hook Weights 10 grams to 1000 grams. This set of weights can be employed to good advantage in other laboratory work. With this assortment it is possible to illustrate the principles of the Wheel and Axle, the Capstan, Fixed Pulleys with power and weight equal, Fixed and Movable Pulleys with power and weight ratios of 1 to 2, 1 to 3, and 1 to 4, and a train of Fixed and Movable Pulleys as illustrated. **$15.00**

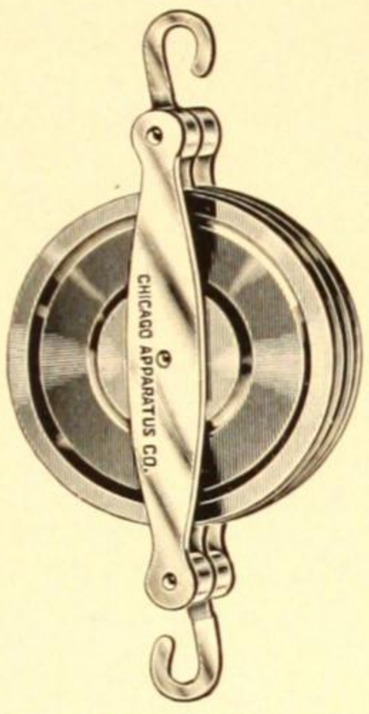
821R. Pulleys, Illustration of, Milvay Bakelite. Offers three distinct advantages over older models with hardwood frames permanently fastened together and with hooks permanently fixed in cross-bar. First, the Support can be used to good advantage in other experiments. Second, the Rods are removable—an advantage in storing the apparatus. Third, the Hooks are adjustable along the cross-bar. This construction makes it possible to keep suspension cords in proper alignment regardless of what combination or arrangement of pulleys is used. The outfit consists of a neatly finished Hardwood Base, with two Threaded Sockets, two Nickel-Plated Support Rods 19 mm. by 80 cm., one Cross-Rod 19 mm. x 100 cm., with eight adjustable Hook Collars, 7 No. 831R Single Bakelite Pulleys, 2 No. 834R Quadruple Bakelite Pulleys, 1 No. 864R set of Triple Tandem Bakelite Pulleys, 1 Capstan, 1 No. 1024R Wheel and Axle, 7 No. 321B 50 gram Weight Hangers, 15 Slotted Weights assorted from 10 to 500 grams, and 25 yards of Pulley Cord. With this outfit it is possible to illustrate the principles of the Capstan, Wheel and Axle, Fixed Pulleys with power and weight equal, Fixed and Movable Pulleys with power and weight ratios of 1 to 2, 1 to 3, 1 to 4, 1 to 5, 1 to 6, 1 to 7, 1 to 8, as well as trains of Fixed and Movable Pulleys. . **$35.00**

Milvay Bakelite Precision Pulleys

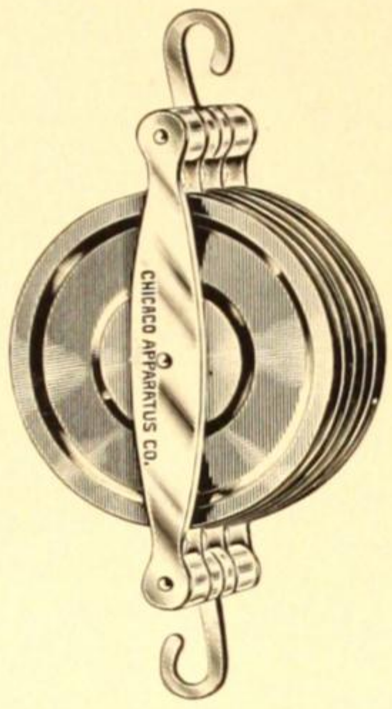
(Reinforced Center Type)



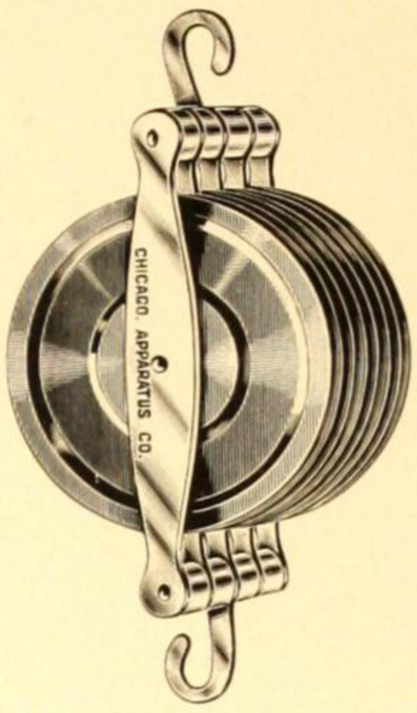
No. 831R.



No. 832R.



No. 833R.



No. 834R.

In every way the finest low-priced pulleys ever built. Turn more freely—run truer—lighter in weight—practically frictionless—cord does not bind or slip in groove—proof against laboratory fumes—far better in appearance—absolutely uniform and far more durable. Bakelite—the material from which the wheels are precision-molded, combines the durability of oak, the hardness of ebony, the uniformity of cocobolo, the lightness of poplar, the strength of hickory and the color and finish of mahogany. Precise and permanent shape, resistance to chemicals, resistance to heat and freedom from wear are other characteristics of this material. For this reason we have replaced wood, stamped and cast metal wheels with Bakelite.

And, because of their design Milvay Bakelite pulley wheels are superior not only to wood and metal pulley wheels, but to other makes of Bakelite wheels as well. This is due to the reinforced center construction—an exclusive Milvay feature—which combines in Milvay Bakelite pulley wheels maximum strength with minimum weight. They will therefore stand the hardest usage, the heaviest loads, and are proof against accidental breakage.

The frames are of aluminum, precision-made with accurate tools and dies. Only quantity production makes possible our low prices for so fine a product. All are provided with two hooks so they may be used either as fixed or movable pulleys. The new hook construction—exclusively Milvay—makes the overall length of all pulleys absolutely uniform. And as all the hooks are absolutely in the center, Milvay pulleys will always hang in a true perpendicular position. Made in four styles as follows:

831R. Pulley, Milvay Precision Bakelite, Single. Bakelite wheel, 5 cm. diameter, in aluminum frame with two hooks **$0.35**

832R. Pulley, Milvay Precision Bakelite, Double. Bakelite wheel, 5 cm. diameter, in aluminum frame with two hooks **$0.45**

833R. Pulley, Milvay Precision Bakelite, Triple. Bakelite wheel, 5 cm. diameter, in aluminum frame with two hooks **$0.75**

834R. Pulley, Milvay Precision Bakelite, Quadruple. Bakelite wheels, 5 cm. diameter, in aluminum frame with two hooks **$0.95**



No. 841R.

841R. Pulleys, Commercial. Tackle blocks of wood, iron strapped, and bushed with steel pins, with 3-inch pulley wheels.

Kind	Single	Double	Triple
No. of wheels in block....	1	2	3
Each	**$0.80**	**1.50**	**2.00**

842R. Pulley Rope. Suitable for use with No. 841R Pulleys. Good quality Manila rope ⅜ inch in diameter. Sold only in lengths of 12 feet or more. Per foot **$0.05**

Milvay Bakelite Precision Pulleys

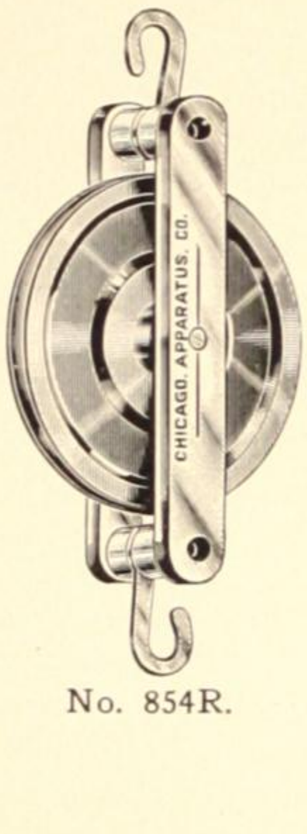
(Reinforced Center Type)



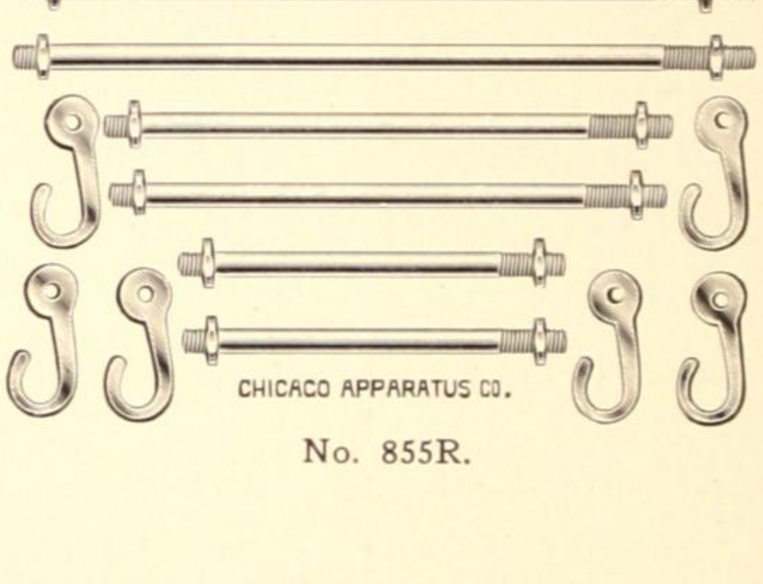
No. 751R.



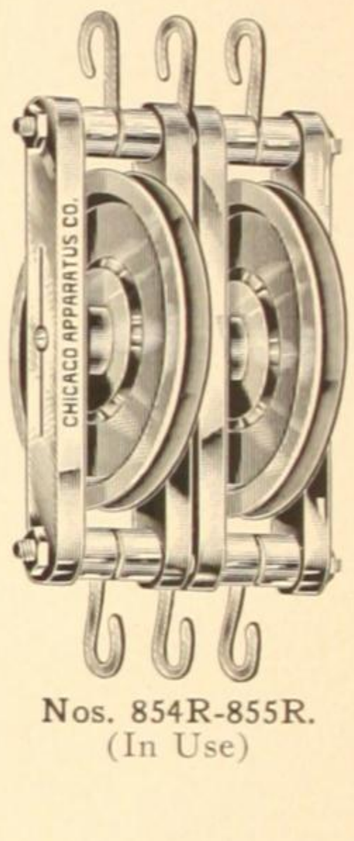
No. 849R.



No. 854R.



No. 855R.



Nos. 854R-855R.
(In Use)

751R. Pulleys, Inclined Plane, Milvay Bakelite Precision. Pulley wheel, 3.75 cm. in diameter, in iron frame with slot, easily attached to any board. Runs freely in cone bearings. Screws for attaching included **$0.60**

849R. Pulley on Rod, Milvay Bakelite Precision. Pulley, 5 cm. in diameter, mounted in metal fork provided with adjustable cone bearings to reduce friction to a minimum. The fork is mounted on an 8 mm. nickel-plated rod 15 cm. long. For use with ordinary laboratory supports; may be clamped in any desired position **$1.00**

854R. Pulleys, Bakelite, Milvay Improved Cone-Bearing. New York Design. Offers many distinct advantages over other makes: Extra heavy construction prevents side-spreading of the frame regardless of load used, and makes readjustment of the cone bearings unnecessary. They form solid, rigid blocks of double, triple and quadruple pulleys, with hooks properly centered, when combined with our No. 855R Rods and Hooks. There are no projecting rods and no side-sliding along loose rods. They are therefore as easy to store, handle and manipulate as regular solid frame pulleys. Furthermore, they may be kept permanently assembled in the most desirable combinations. They are then always ready for use and the loss of rods is prevented. No other New York Design pulley offers these advantages. Bakelite reinforced center pulley wheel, 5 cm. diameter; frame of solid brass, provided with two hooks for use either as fixed or movable pulley. Cone bearings have slotted heads for adjustment with small screw driver. Cone-bearing heads do not project, leaving frame sides perfectly flat..... **$1.00**

N. B. For advantages of Milvay Bakelite reinforced center pulley wheels see page 315.

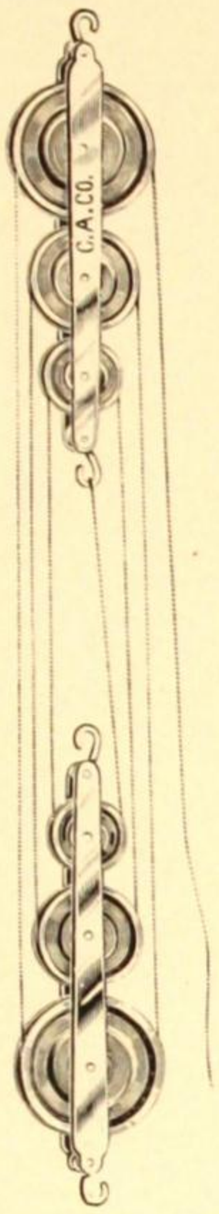
855R. Rods and Hooks. Milvay. One pair each double, triple and quadruple pulley rods with lock nuts and three pairs of hooks for combining No. 854R Pulleys. **Per set**..... **$0.35**

857R. Eight Pulleys Assortment with Rods and Hooks. Consists of eight No. 854R Pulleys and two sets of No. 855R Rods and Hooks to assemble any of the following combinations: eight single pulleys, four double pulleys, two triple pulleys or two quadruple pulleys **$7.85**

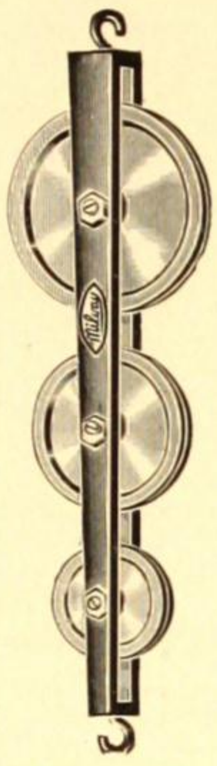
858R. Twenty Pulleys Assortment with Rods and Hooks. Consists of twenty No. 854R Pulleys and two sets of No. 855R Rods and Hooks to assemble the following combinations: two single pulleys, two double pulleys, two triple pulleys, and two quadruple pulleys. These combinations cover practically every need and therefore may be left permanently assembled **$18.65**



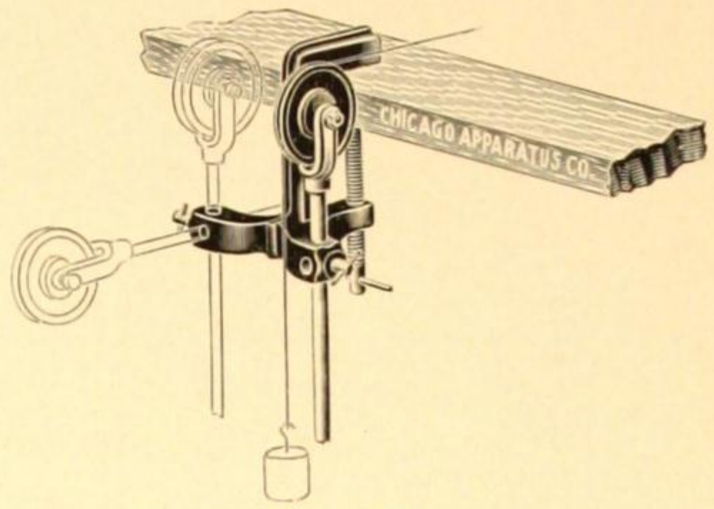
No. 862R.



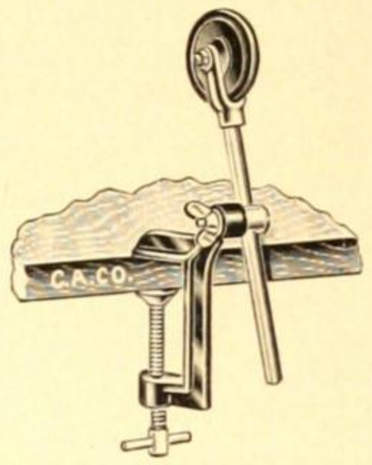
No. 864R.



No. 869R.



No. 870R.



No. 874R.

862R. Pulley, Ball-Bearing. Useful wherever minimum friction is important, as in inclined plane experiments, Atwood's machines, etc. The wheel, of aluminum, is 10 cm. in diameter and has ball-bearings in both ends of the hub. A convenient adjusting screw permits close regulation of the clearance between the balls and their races. The groove in the rim is flat, 3 mm. wide by 2.8 mm. deep. The mounting includes a 20 cm. x 10 mm. rod for convenience in attaching the pulley to any system of supports. All parts are finely machined and finished....**$10.00**

864R. Pulleys, Triple Tandem, Milvay Bakelite Precision, Plain Bearing. Three reinforced center Bakelite pulleys of different diameters, 25, 37.5 and 50 mm., mounted in line, in finely finished machined metal blocks. Being provided with two hooks, they may be used either as fixed or movable pulleys. Far more accurate and serviceable than any other triple tandem pulleys selling at about the same price. Without cords or weights. **Per pair of blocks.....$3.50**

865R. Pulleys, Triple Tandem, Milvay Bakelite Precision, Plain Bearing. Single block of 864R only **$1.75**

869R. Pulleys, Triple Tandem, Milvay Bakelite Precision, Cone-Bearing Type. These are the finest quality triple tandem pulleys we manufacture. The reinforced center Bakelite pulleys, mounted in improved cone bearings, run with a freedom and smoothness never before attained in pulley construction. The frame is of aluminum and of such substantial construction that the cone bearings will retain their perfect adjustment under all conditions of use. Consists of three pulley wheels—25, 37.5 and 50 mm. diameter—in a heavy, rigid aluminum block. With two hooks for use either as fixed or movable. **Per block $3.50**

870R. Pulley with Clamp, Milvay, with Bakelite Pulley. A new clamp that will prove valuable in experiments such as Melde's, composition of forces, acceleration, assembly of simple sonometers and many others. The string passing over the pulley is always clear of the upper portion of the clamp. Furthermore, the pulley can be adjusted so that the string is held directly on the table top or at any point up to 13.5 cm. above it. In addition, the pulley may be clamped in either a vertical or horizontal position and on either side. Fits any table top up to 6.5 cm. thick. The Bakelite pulley is 2 inches in diameter and mounted on adjustable cone bearings in metal fork with 10 mm. diameter nickel-plated rod 20 cm. long. It can be entirely removed for other purposes if desired. The clamp is of cast iron finished in black gloss baked enamel. No other clamp offers the wide range of adjustability, adaptability and usefulness to be found in this new Milvay design.....**$2.50**

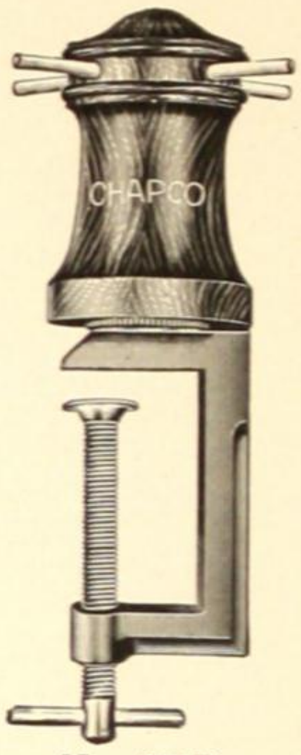
874R. Pulley, Universal, with Clamp, Milvay Bakelite Precision. 5 cm. diameter cone-bearing pulley in metal fork on 8 mm. x 15 cm. nickel-plated rod. This pulley is so mounted on a table clamp that it may be used in an unlimited number of positions, a feature which makes this pulley useful in many experiments. Fits table tops up to 7 cm. thick.....**$2.50**



No. 875R.



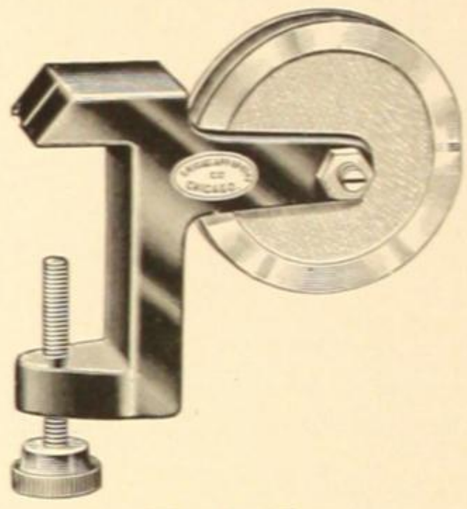
No. 880R.



No. 876R.



No. 298B.



No. 879R.

875R. Pulley, Differential. Commercial type, ¼-ton capacity, regular lift 6 feet, net weight 23 pounds. **$16.00**

880R. Pulley, Hoist, Differential, Milvay 5 Kilo Laboratory Model. Designed to be suspended from standard laboratory supports and to be used with standard laboratory weights. This is a distinct advantage over the smallest commercial type made (see No. 875R) which requires a special support and special extra heavy weights. Mechanical advantage 30 to 1; weight may be lifted, about 2 feet; diameter of upper pulleys, about 1¾ inches; diameter of lower pulley, 1½ inches; capacity, 5 kilos. The ball chain never becomes tangled nor can it leave the pulley grooves. It is always ready for use. The design is such that factors for calculating the mechanical advantage can be obtained by direct measurement. The friction is so low that the calculated mechanical advantage can be verified by determining the downward pull with a spring balance and comparing it with the load lifted. The result will be quite close. Without weight or support **$6.00**

876R. Capstan. Demonstration model, on metal clamp, with ratchet base. This capstan is a true working model of the type used on board ships and in house moving. The drum is made of polished hardwood and is provided with four hand levers. A toothed wheel and pawl at the base permits the drum to be turned in one direction only. Fits table top 7 cm. thick or less..... **$5.00**

879R. Pulley with Clamp, Milvay Bakelite Precision. The convenience of this pulley will be especially appreciated in composition of forces experiments. The Bakelite pulley is 5 cm. in diameter and mounted on hardened steel cones provided with lock nuts, thereby reducing friction to a minimum. The clamp, finished in black japan, fits board or table tops 10 to 35 mm. in thickness. An index line, as shown in the illustration, is placed opposite the groove of the pulley **$1.50**

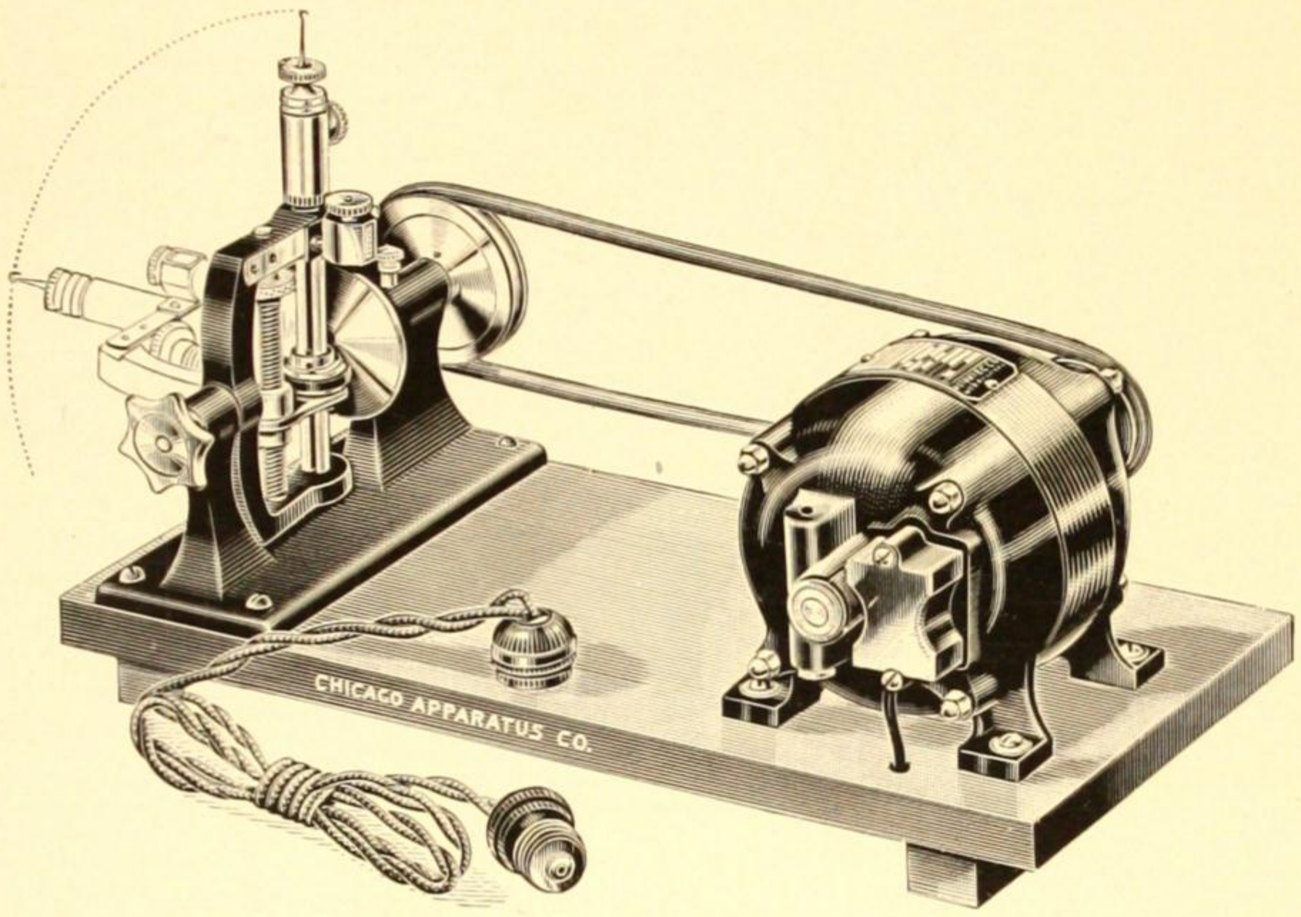
884R. Pulley Cord. (Fish Line.) Cotton, hard braided, black and gold color, 25 yards on a card. **Per card** **$0.25**

885R. Pulley Cord. (Fish Line.) Genuine silk, 25 yards on card. Per card **$0.50**

889R. Pulley Cord. Twisted flax, extra fine quality, for use in pulley experiments, etc. **Per ½-lb. ball $1.00**

298B. Pulley Weight, Milvay Leather-Covered, 2000 Gram. Designed after suggestions by the science teachers of St. George High School, Evanston, Illinois. Positively will not mar or injure table tops, like metal weights do, when they accidentally drop because of slippage or breakage of pulley cords. Leather covering is very thick—$\frac{3}{16}$ inch—providing utmost durability. The large size—11x8 cm.—is an advantage in lecture work. Has heavy brass hook and is accurately adjusted to 2000 grams..... **$3.00**

Milvay Friction-Drive Rotator



No. 892R.

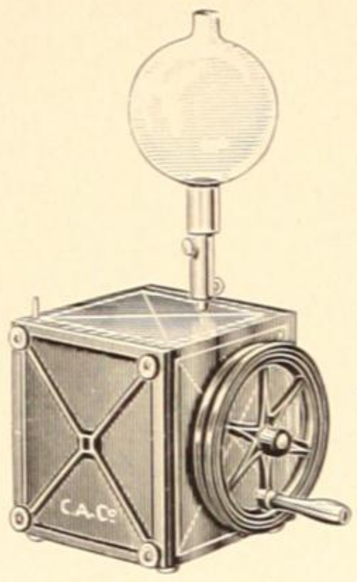
892R. Rotator, Milvay Electric Friction-Drive. The outstanding characteristic of this rotator is the smooth, steady, powerful spindle action at all rotator speeds. The utilization of full motor speed and full motor power at all rotator speeds produces this result. The entire rotator speed range—10 to 2500 R. P. M.—is always at the operator's command; a turn or two of the adjusting screw—while the machine is running—silently, smoothly and quickly varies the speed to the desired point. Inclining the spindle to horizontal or any other position—and this can also be done while the machine is running—requires only the loosening and tightening of the disk-handled lock screw. The speed indicator is securely mounted on a flat spring. A slight pressure of the finger engages it and it disengages itself instantly when the pressure is released. The counter registers up to 99,999 and is indispensable in quantitative work. The friction-drive mechanism is sturdy, accurate and runs absolutely true. A special non-slip friction material transmits full power at all speeds. The motor is a standard 1/20 H. P., continuous duty, constant speed type, for use on 110-volt A.C. 60 cycle circuits. Complete, on 18x8-inch finely finished base with belt and detachable cord and plug.....**$55.00**

892Ra. Rotator, Milvay Electric Friction-Drive. Same as No. 892R, but with motor for use on 110-volt 25 cycle A.C. circuits.....**$60.00**

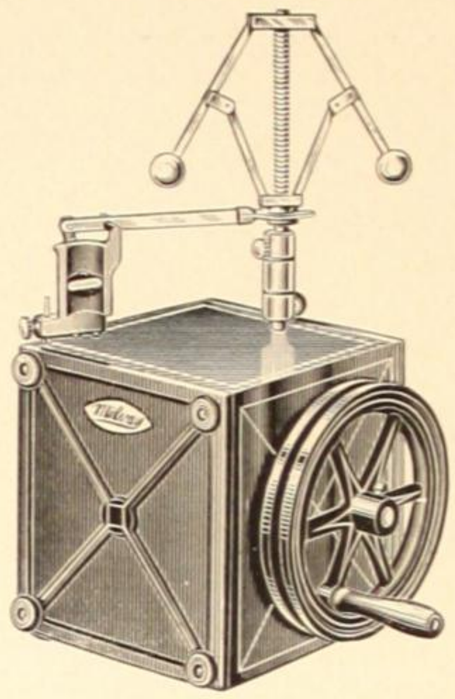
893R. Rotator, Milvay Electric Friction-Drive. Same as No. 892R, but with motor for use on 110-volt D.C. circuits **$56.00**

894R. Rotator, Milvay Friction-Drive. Same as No. 892R, but without base, motor or belt. Any 1/20 H. P. motor furnishes ample power to operate this unit. With a two-inch motor drive pulley the maximum spindle speed will be 50% greater than the motor speed, while a 1½-inch pulley on the motor will increase the maximum spindle to 100% above the motor speed. Complete friction-drive rotator unit on 8x3½-inch metal base with four screw holes. **$30.00**

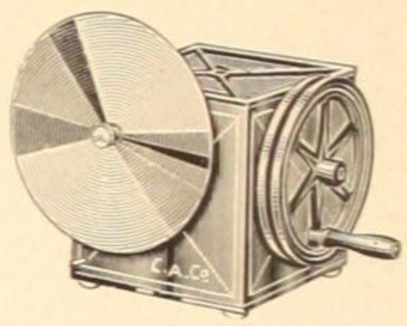
Ten Advantages of the Milvay Gear-Drive Rotator



(With No. 944R Glass Globe).



No. 896R.
(With No. 949R Watt's Governor).



(With No. 52K Newton's Color Disk).

896R. Rotator, Milvay Gear-Drive, with Speed Indicator. Offers the following important advantages over belt and electric drive machines:

1. **No Complicated Adjustments or Moving Parts** to divert the student's attention from demonstrations—an important consideration from a teaching standpoint.

2. **Absolutely Noiseless.** The absence of distracting noises is another valuable feature from a teaching standpoint.

3. **Perfect Stability.** Requires no clamping, nor does it need to be held down, regardless of the weight, size, or speed of the accessory being whirled. One hand operates the machine perfectly at all speeds.

4. **Wide Speed Range.** All speeds up to 4,000 r. p. m. are at the operator's command. As the "flicker" in color mixing disappears at about 2,500 r. p. m., perfect work in this field is assured.

5. **Velvety Smooth Action.** Due to the mechanical accuracy and the design of the driving mechanism, the action is as smooth as velvet, there being no vibration or chatter whatsoever.

6. **Extreme Ease of Operation.** So nicely is the driving mechanism made, and so nicely is it balanced that the highest speed can be almost instantly reached with but slight effort, and any required speed can be maintained with the utmost ease. Unlike in belt drive machines, the accessory does not stop whirling the instant that driving power is released, but continues to whirl at a slowly decreasing rate, which is a big advantage in many demonstrations, such as Watt's Governor, Doppler's Principle, etc.

7. **Concealed Non-Removable Accessory Support Rod.** For supporting the steam chest in Watt's Governor, the commutators in Earth Induction and Doppler's Principle Experiments, and the glass plate with needle in Arago's Magnetic Experiments, a nickel-plated support rod is conveniently located in one corner of the rotator. It is instantly adjustable, and a thumb screw locks it at the required height. This rod cannot be entirely removed and, therefore, cannot get lost. When not in use it slides down into the rotator, where it is always at hand when needed.

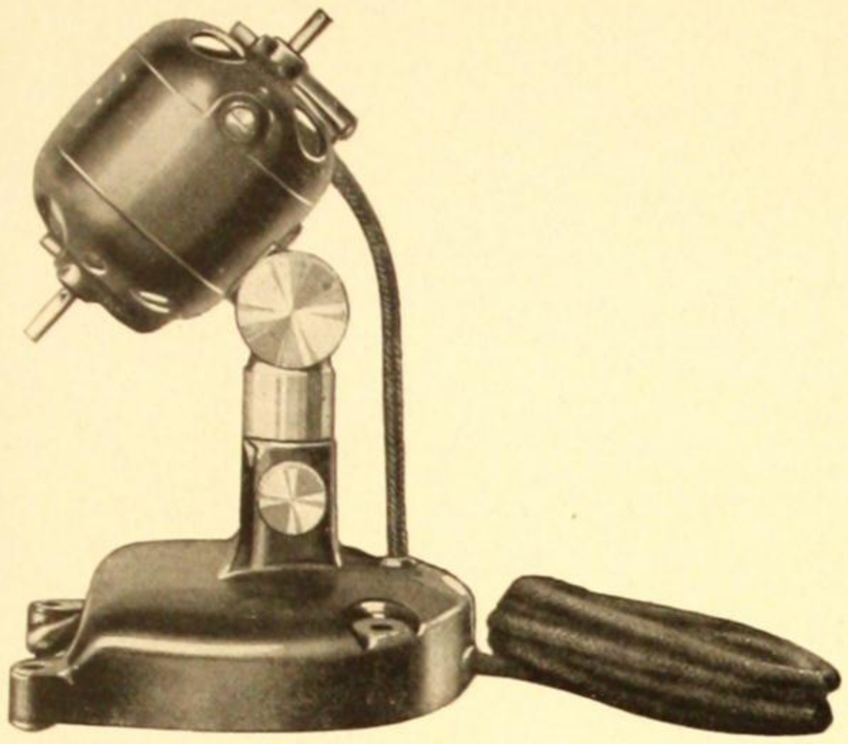
8. **More Convenient Than Electric Rotators.** No electrical connections to establish; no slow and complicated rheostat adjustments; no fuses to blow; no commutators to clean; no electrical connections to worry about; easily transportable, and since it does not depend on electricity for power, may be used anywhere, any time.

9. **Handles All Accessories Perfectly.** Being designed to operate in any position, and being provided with a standard chuck and disk holder, it will handle all accessories perfectly, regardless of weight, size, speed or position.

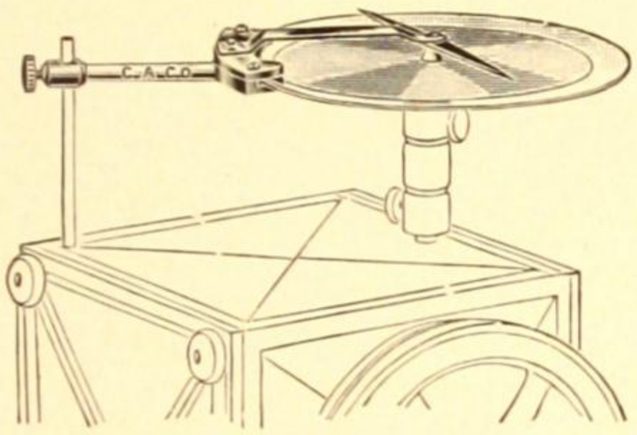
10. **Durability.** The excellent workmanship and the substantial size of all parts insure a lifetime of service. Three of these rotators were operated almost continuously for four days at the 1925 N. E. A. Convention—more use and abuse than they will ever receive in a lifetime in any laboratory. Minute inspection of these rotators on their return to our Research and Testing Laboratories showed absolutely no sign of wear.

Construction. The gear-drive mechanism is entirely enclosed in a heavy cubical metal body. Total weight, 30 lbs. The driving mechanism is of the finest mechanical construction and operates perfectly in either direction. In either position, horizontal or vertical, the machine rests on four large rubber feet, which prevent marring the table top. The body and drive wheel is finished in non-chip black baked enamel with decorative gold striping, while the chuck and disk holder are finished in polished nickel-plate. The speed indicator (not shown in illustration) is securely mounted on a flat spring. A slight pressure of the finger engages it and it disengages itself when the pressure is released. It registers up to 99,999.

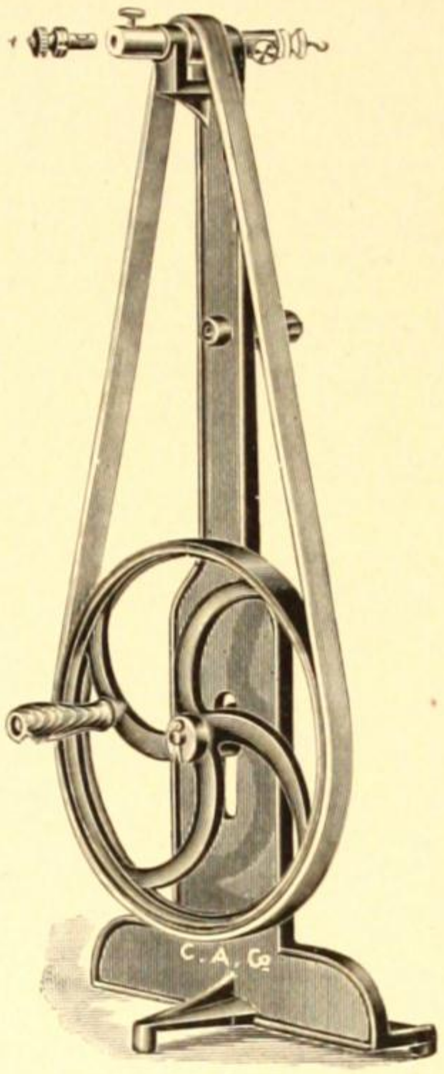
Thirty-Day Free Trial Offer. To demonstrate the advantages of this new rotator in your own school we are glad to make shipment on our 30-day free trial plan, because we know that you will not want to be without this superior rotator once you fully become familiar with its merits. Should you, however, for any reason wish to return it in thirty days, you may do so at our expense.....**$25.00**



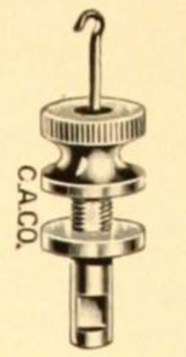
No. 898R.



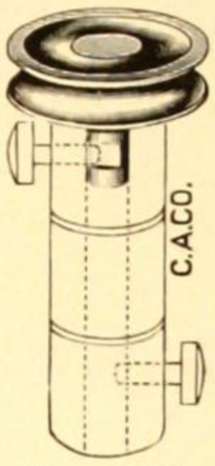
No. 11E (in use).



No. 900R.



No. 902R.



No. 904R.



No. 906R.

898R. Rotator, Electric. For rotating centrifugal apparatus of various kinds, stirrers, photometers, calorimeters, color disks, and other laboratory devices. Has switch in base for regulating speed. No load speed—10,000 r.p.m. Full load speed—6,000 r.p.m. Horse power—1/30th. Motor body measures 3⅛ inches diameter by 4 3/16 inches long. Shaft is ¼ inch in diameter and projects one inch from each end. The hinge joint makes possible adjustment to any position from horizontal to vertical. The motor is of the UNIVERSAL TYPE and operates on either 110 volt A.C. or D.C. current. Complete with grooved pulley (not shown in illustration) and cord with two-piece plug.....**$25.00**

899R. Chuck. For use with No. 898R in rotating attachments such as color disks, siren disks, cubic mirrors, glass globes, etc. **$1.75**

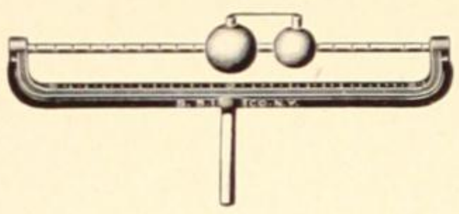
900R. Rotator, High Speed. (Whirling Table.) Made entirely of metal, finished in black japan. Can be used in either vertical or horizontal position, also with spindle projecting over edge of table for rotating suspended attachments. The wheel is 23 cm. in diameter and mounted on a tension slide for tightening the belt. Employing a flat leather belt (19 mm. wide) makes it possible to use a very small pulley on the rotator head. As a result one revolution of the drive wheel causes nine revolutions of the rotator head. The rotator head is so designed that all accessories can be revolved on either side of the machine. This will be found especially convenient in lecture table work. The base is extra large to insure proper stability when the rotator is used in an upright position. Height, 61 cm. **$9.00**

902R. Rotator Spindle with Hook. Fits any Rotator. For holding siren disks, color disks and suspended attachments **$0.75**

904R. Pulley. Fits Any Rotator. Diameter, 1½ inches; grooved for round leather belt up to 5/16-inch diameter. Made of nickeled brass.....**$2.00**

906R. Rotator, Simple Form. For rotating the various accessories listed below. Rotation is secured by pulling a cord wound about the drum. Mounted on clamp, fits table tops 7 cm. thick or less. Complete with No. 902R Disk Holder Spindle for rotating color disks, etc. **$5.00**

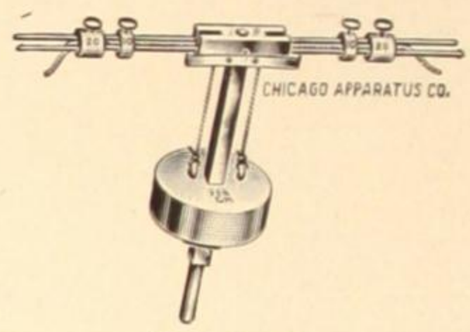
11E. Arago's Magnetic Rotation Apparatus, Milvay. This is an improved form in which the needle cannot get lost. Consists of a revolving copper disk—15 cm. diameter—over which is placed a stationary glass plate having a delicate magnetic needle pivoted at its center. Slow rotation deflects the needle in the direction of rotation, the needle stopping at an angle from the magnetic meridian, depending on the speed. With increasing speed the needle is deflected more and more until it makes complete revolution. Effectively demonstrates Lentz's law—the law governing the action of magnetic drives in speedometers, recording mechanism in wattmeters, etc. Fits any Rotator. (Illustration shows the apparatus mounted on No. 896R Milvay Gear Drive Rotator.....**$9.00**



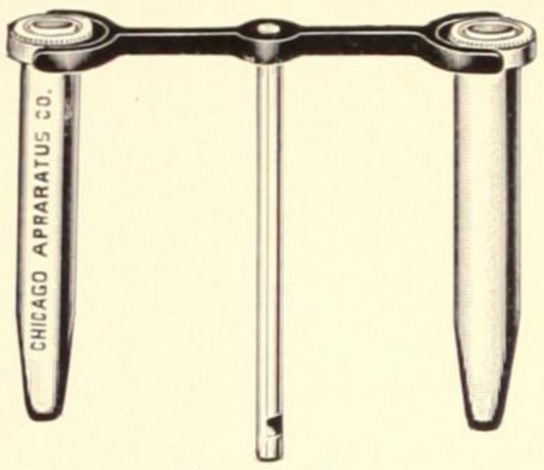
No. 909R.



No. 915R.



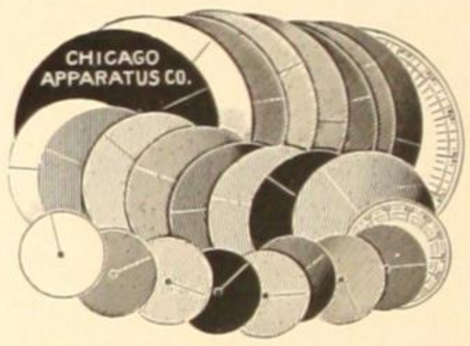
No. 925R.



No. 928R.



No. 52K.



No. 57K.

909R. Centrifugal Force Apparatus. Two balls, 2.5 and 3.8 cm. in diameter, of unequal weight, fastened together, and mounted in metal frame about 20 cm. long. Provided with 8 mm. spindle. Fits any Rotator **$2.50**

915R. Centrifugal Hoop. Double Hoop Form. For showing the flattening of the earth's poles due to rotation. Consists of a spring steel ring, 25 cm. in diameter, so mounted on an axis that the top of the ring may slide freely up and down. Provided with an 8 mm. spindle. Fits any Rotator..... **$1.25**

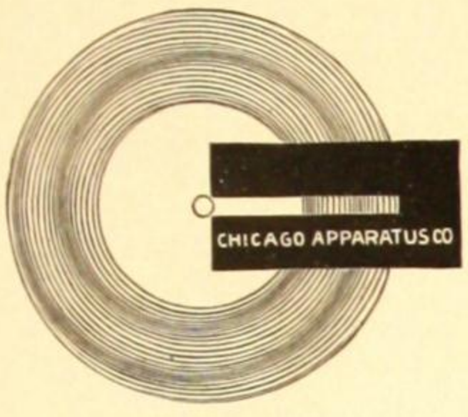
925R. Centripetal Force Apparatus. For quantitative as well as demonstration work on centripetal force. Provided with two pairs of sliding weights of 10 and 20 grams, respectively, which can be clamped to the cord at any desired radius. This makes possible the performance of the experiment with 10, 20 and 30 grams respectively. The large weight representing the centripetal force slides freely on the square vertical rod. This rod is provided with suitable stops to confine the motion of the large weight, within small limits in quantitative experiments. In demonstration work the top stop is removed, thus permitting the large weight to move through a wide range visible to even a large class. Fits any Rotator. **$10.00**

928R. Centrifugal Separator. For separating by centrifugal force solids held in suspension in a liquid. Consists of an 8 mm. spindle with cross-head from which two aluminum shields, 12.5 cm. long, are suspended. In each of these shields is a removable glass tube in which the liquid is held and in which the deposit of solids may be readily inspected. Fits any Rotator **$3.25**

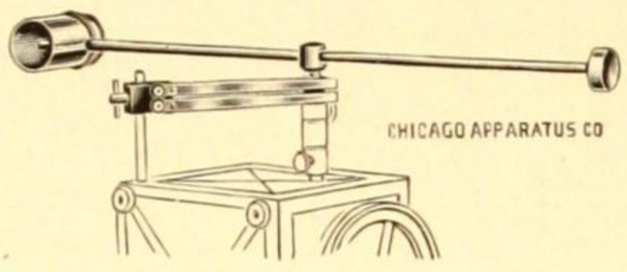
52K. Color Disk, Newton's Milvay Improved. The colors on this new improved disk are processed directly on the metal. This method permits washing of the disk when it becomes dirty, likewise there is no peeling of a colored paper surface rendering the disk unfit for use, such as occurs in ordinary forms. Disk is 20 cm. diameter. On one side are the seven primary colors properly proportioned for recomposing white light. On the other side are equal portions of red, yellow, and blue—Brewster's Disk—which appears white or gray on rapid rotation, 6 mm. center hole. Fits any Rotator **$1.00**

57K. Color Disks. Four complete groups of color disks for color analysis, recomposition of white light, etc. Sizes, 8, 14, 20 and 25 cm. in diameter. Each set contains violet, blue, green, yellow, orange, red, black, white disks and a graduated disk for quantitative color mixing. In neat cardboard box. 6 mm. center holes. Fits any Rotator..... **$4.50**

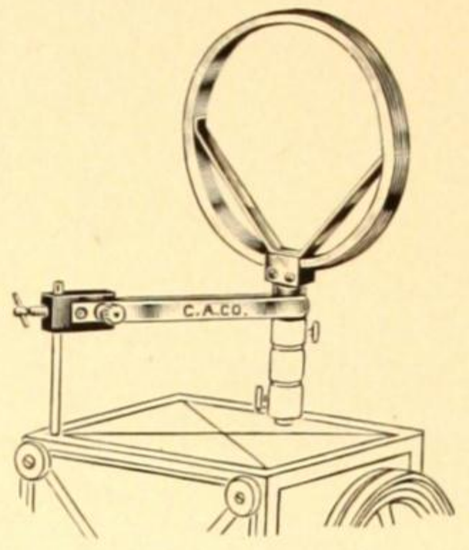
62K. Color Disks. Two sets, 8 and 14 cm. in diameter; each set contains violet, blue, green, yellow, orange, red, black and white disks. A graduated disk for quantitative work in color mixing, which may be used with either set, is included. Illustrating shading, blending, changing of colors, complementary colors, Maxwell's cut color disks. With 6 mm. center holes. Fits any Rotator..... **$1.50**



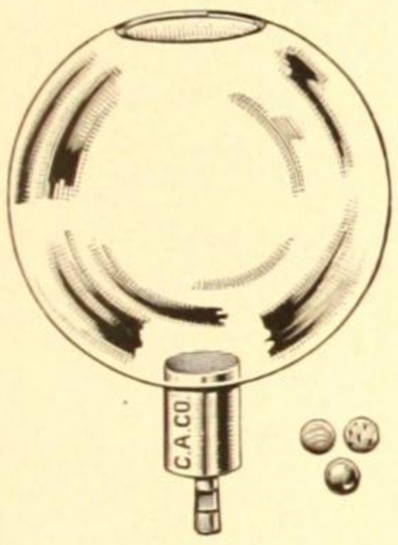
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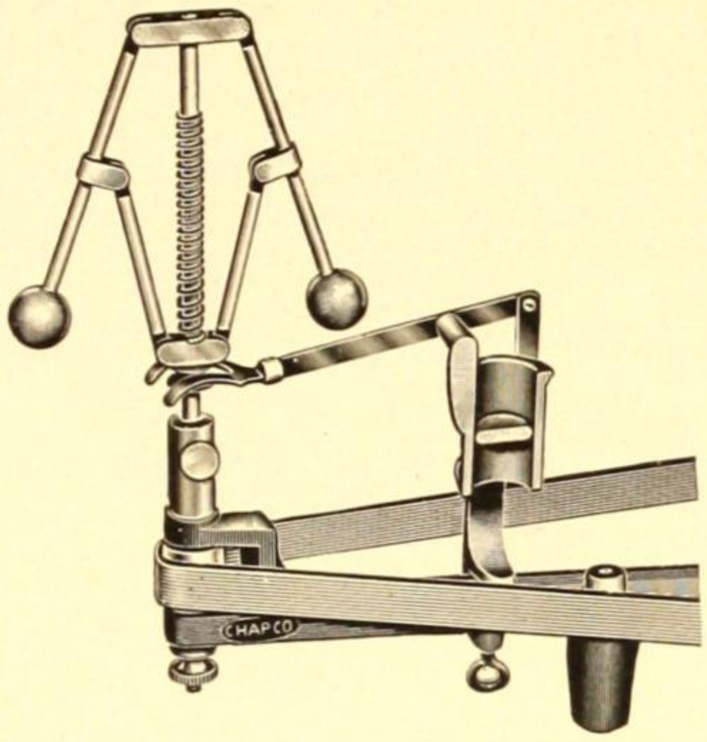
No. 933R (in use).



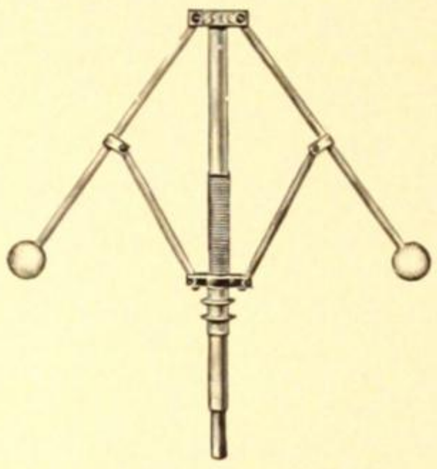
No. 413E (in use).



No. 944R.



No. 949R.



No. 950R.

515S. Crova's Disk. For illustrating waves of condensation and rarefaction. A white cardboard disk, 30 cm. in diameter, with a series of black eccentric circles on it. When this disk is rotated and a slit held in front of it, a very realistic wave effect is seen. Complete with slit. Fits any Rotator.....**$1.10**

933R. Doppler's Principle Apparatus, Milvay Electric Design. Consists of an electrically operated buzzer mounted on the end of a 60 cm. rod. When operated this buzzer apparently gives forth notes of different pitch—higher when it moves towards and lower when it moves away from the observer. Operates on a single dry cell. Far more convenient and yields far better results than the older models. Fits any Rotator **$5.00**

413E. Earth Induction Apparatus, Milvay. A new design which yields far more satisfactory results. The frame is extremely rigid. It does not wobble or vibrate at any speed. The coil—15 cm. in diameter—has a far larger number of turns and generates a much heavier current. This eliminates the use of the highly sensitive suspension type galvanometers required with the former models and the current generated may be shown on a portable galvanometer, like our No. 574E. Our laboratory tests show that this new design will produce deflections 5 to 30 divisions on our No. 574E Milvay Portable Galvanometer, the amount of deflection depending upon the position of the rotating coil with respect to the earth's magnetic axis. Provided with $\frac{5}{16}$ in. standard spindle, fitting any make of rotator. Fits any Rotator. The illustration shows the apparatus mounted on the new Milvay Gear Drive Rotator. Complete with commutator and conducting brushes....**$15.00**

944R. Glass Globe. Fits any Rotator. For showing the effect of rotation upon solids and liquids of different weights. When three balls of the same size but of unequal weight, or two or more liquids of different specific gravity but which do not mix (water and mercury) are placed in the globe and the globe rotated, the effect of centrifugal force will be noted. Consists of a glass globe, 15 cm. in diameter, with 5 cm. opening in the top and provided at the bottom with a metal spindle to fit the rotator chuck. Including three small balls of unequal weight..**$3.75**

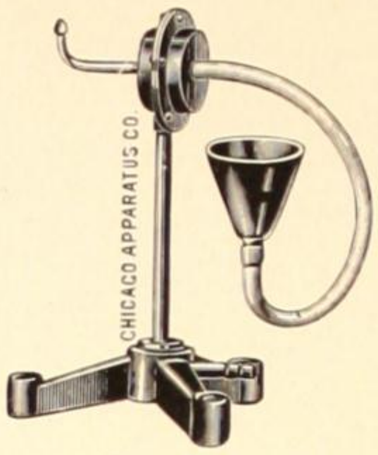
949R. Governor, Watt's, with Valve Regulating Gear. For showing how governors on engines maintain uniform speed by regulating the supply of steam to the steam chest. As the speed rises the valve closes, as it falls the valve opens. This model shows clearly the principle of centrifugal force involved, also the manner in which the motion of the governor is transmitted to the valve. Made entirely of metal, finely finished. Height of governor about 18 cm. Fits any Rotator **$13.50**

950R. Governor, Watt's. Only, of No. 949R.... **6.75**

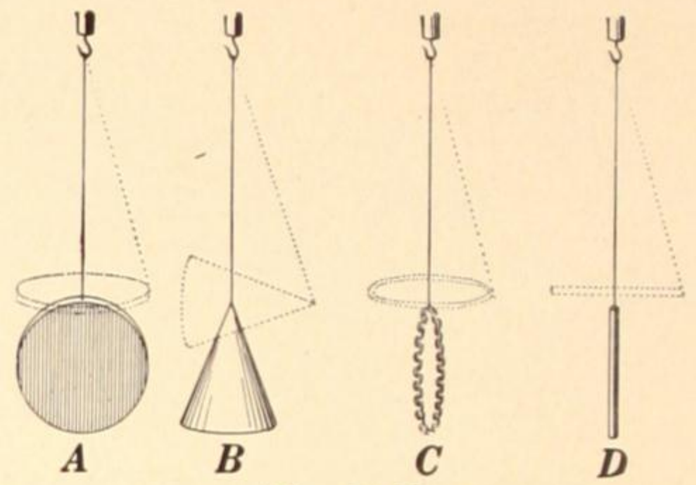
951R. Regulating Gear. Only, of No. 949R..... **6.75**



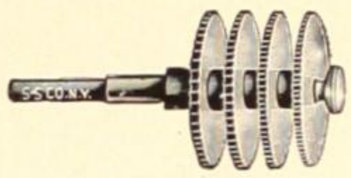
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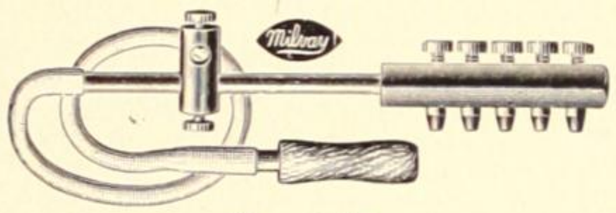
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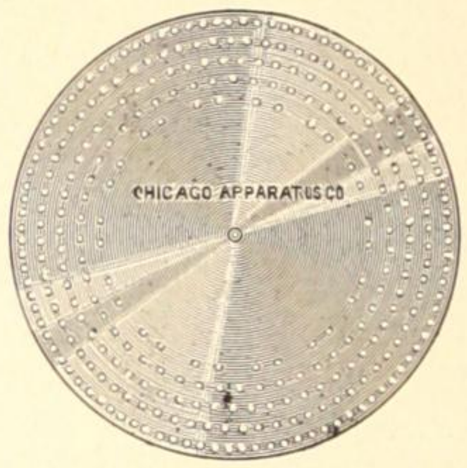
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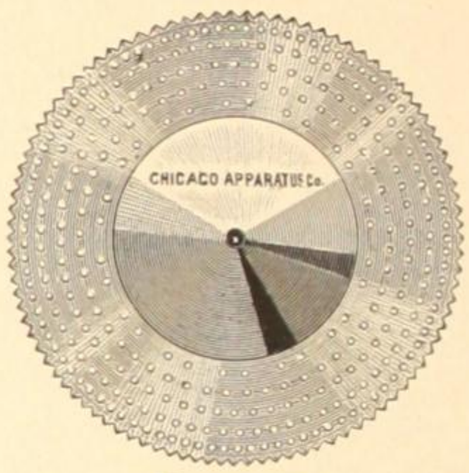
No. 605S.



No. 984R.



No. 969R.



No. 974R.

954R. Manometric Flame Mirror. Size 11x11x11 cm., strong wooden frame, best quality mirrors, 6 mm. spindle accurately centered and balanced. Fits any Rotator **$5.00**

955R. Manometric Flame Vibrator. Metal gas chamber with sensitive membrane, japanned iron stand, improved flame tip, mouthpiece with flexible tube **$4.00**

259W. Extra Membrane. For No. 955R, of goldbeater's skin, about 6 inches square..... **$0.15**

959R. Ring, Cone, Chain and Cylinder. Suspended attachments for use with rotators for demonstrating the tendency of bodies to rotate about their shortest diameter. Greatest diameter of each body is about 6 cm. ..... **Per set $0.80**

605S. Savart's Toothed Wheels. Four metal wheels, 75 mm. in diameter, each having a different number of teeth. Will sound a major chord when rotated rapidly and card held against the teeth. Mounted on a common axle. Fits any Rotator..... **$2.75**

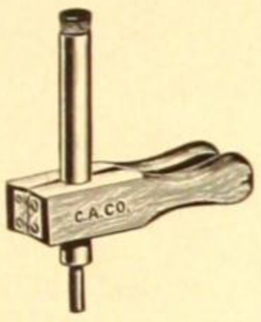
969R. Siren Disk. Metal, 22.5 cm. in diameter. Has five rows of holes, four evenly placed, giving the chord do-me-sol-do; the other, unevenly spaced, a noise. 6 mm. center hole. Fits any Rotator..... **$1.25**

974R. Siren Disk and Color Disk. Milvay Improved. Metal, 24 cm. in diameter. Has five rows of holes, four evenly spaced and one evenly spaced; toothed edge and primary colors in proper proportion in center. These colors are processed directly on the metal which permits washing of the disk when it becomes dirty, likewise there is no peeling of a colored paper surface rendering the disk useless, such as occurs in ordinary forms.

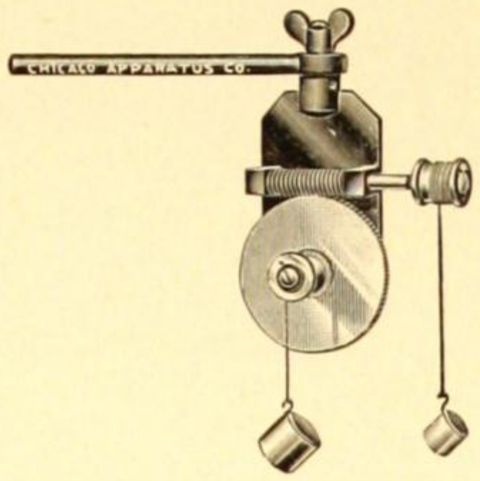
Three disks in one—Siren Disk, Savart's Wheel, and Newton's. 6 mm. center hole. Fits any Rotator **$2.00**

979R. Siren Disk Air Jet Tube. Metal, for directing a current of air against the rows of holes in siren disks. Length, about 20 cm..... **$0.25**

984R. Siren Disk Air Jet Attachment, Milvay. For use with Nos. 969R and 974R Siren Disks for sounding the tones singly or together. Consists of a metal tube with five jets spaced the same as the rows of holes on the disks, each jet having an easily operated valve. Complete with rubber tube, mouthpiece and clamp for attachment to fit any Rotator..... **$3.75**



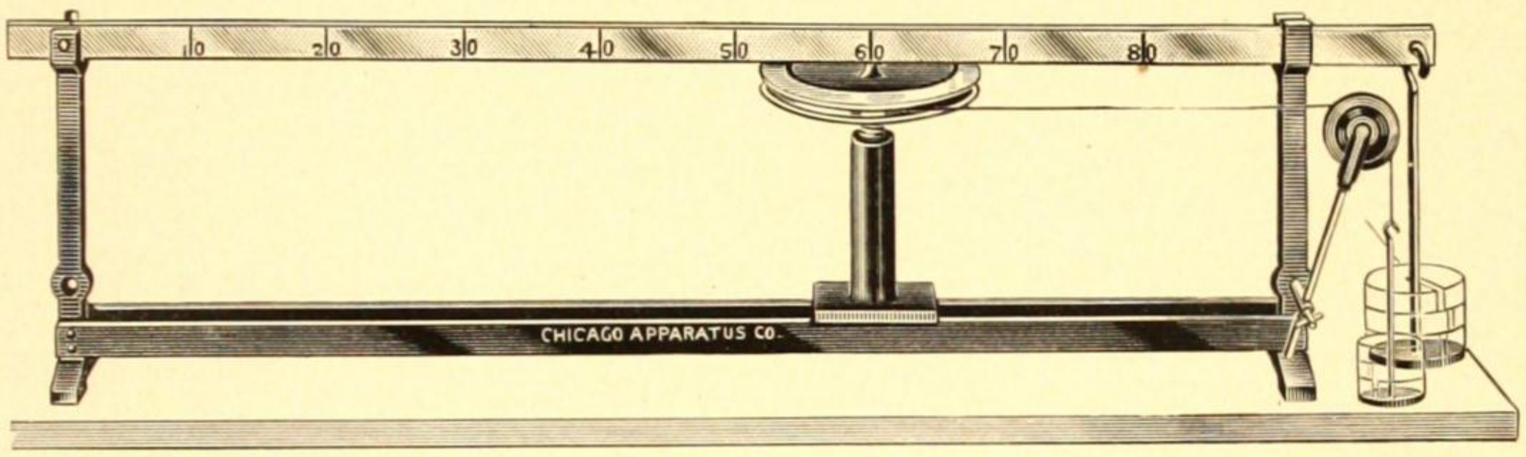
No. 989R.



No. 994R.



No. 999R.



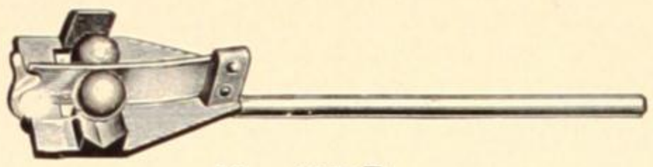
No. 1000R.

989R. Tyndall's Friction Cylinder. Consists of a 19 mm. x 15 cm. hollow brass cylinder, with 8 mm. spindle, cork and wood friction clamp. When the cylinder is partly filled with alcohol or ether and rotated rapidly between the jaws of the clamp, the liquid is caused to boil by the frictional heat developed. Fits either No. 900R or No. 896R Rotator **$1.75**

994R. Screw, Endless. For determining the mechanical advantage of a gear operated by a screw. Consists of a disc gear, 7.5 cm. in diameter, provided with a drum for attaching the weight. This gear is actuated by an endless screw, one end of which terminates in a drum for attaching the power weight. The mechanical advantage is 150. Adjustably mounted on a 10 mm. rod so that the apparatus may be clamped to a support. Made entirely of metal, neatly finished **$8.00**

999R. Screw, Jack. Working model, made entirely of steel, neatly finished, capable of raising 1000 pounds or more. Diameter at base, 32 mm.; range, 63 to 92 mm. **$1.25**

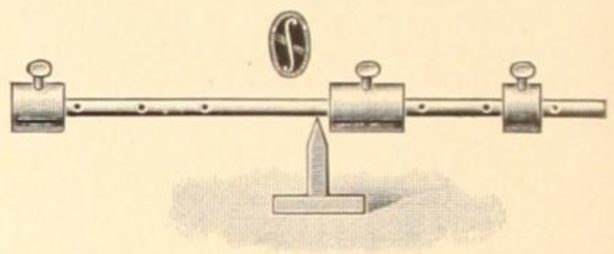
1000R. Screw, Jack, Tester, Milvay. Solid rigid construction distinguishes this new Milvay tester from others. The jack screw slides on a heavy double-rod bed which does not "give" under the heaviest loads. The pulley head of the screw is made of aluminum instead of wood, as heretofore, and is therefore free from warpage. At the center of this pulley head is a ball-bearing on which the lever rests, reducing friction to a minimum. Small concavities along the underside of the lever keep it properly centered on the screw head. Power is applied to the jack screw pulley head by means of weights attached to a cord passing over a Milvay Reinforced Center Pulley at the side of the apparatus. This pulley is adjustable so that the pull may be applied at a tangent to the rim of the pulley head. Furthermore, the position of this pulley may be changed to either side or end of the apparatus. Power may be applied if desired with a spring balance. The lever is a heavy steel bar about 105 cm. long, graduated in decimeters, pivoted at one end, and with knife edge for weight hanger at a distance of 100 cm. from the axis. Complete as illustrated with one small and one large weight hanger, but without weights. (For slotted weights for use with this apparatus see No. 311B and No. 331B) **$40.00**



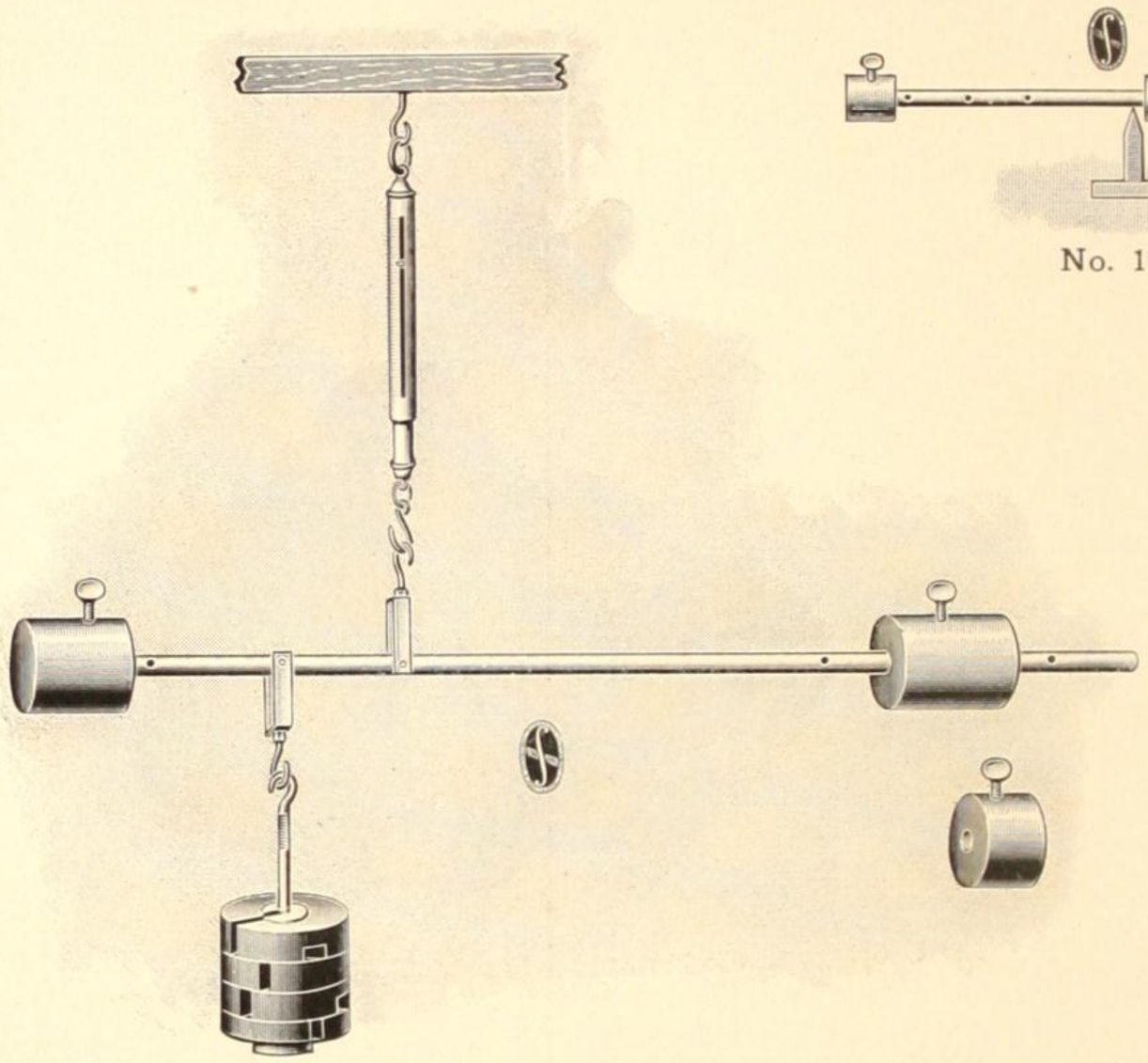
No. 1004R.



No. 1006R.



No. 1007R.

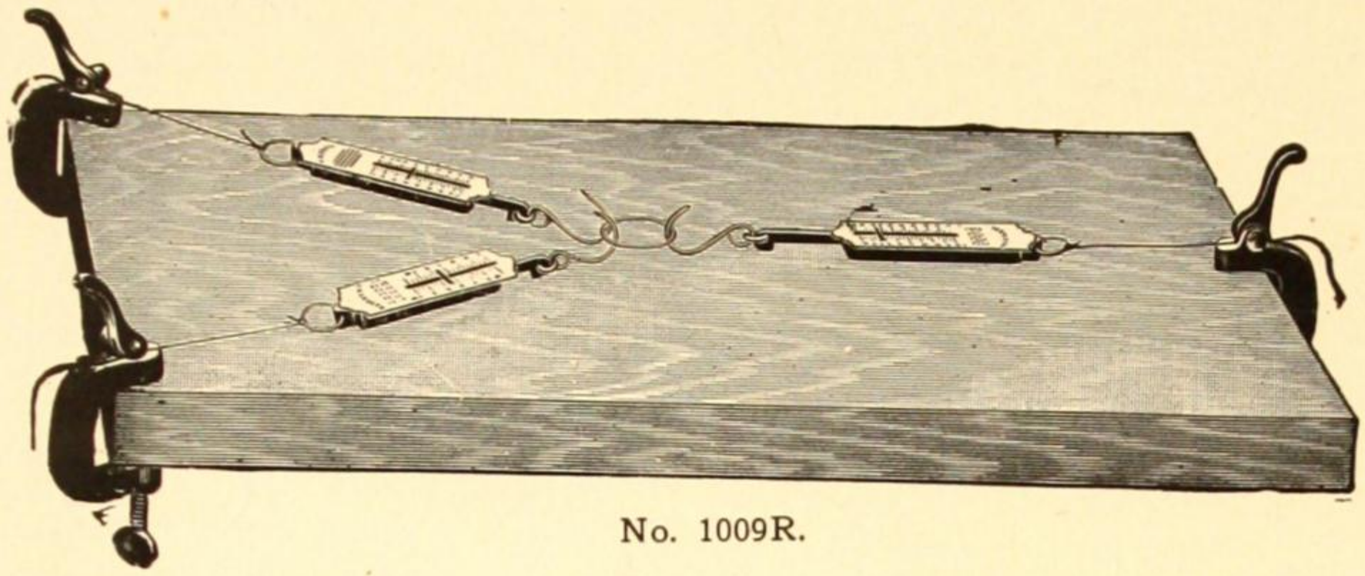


No. 1007R (in use).

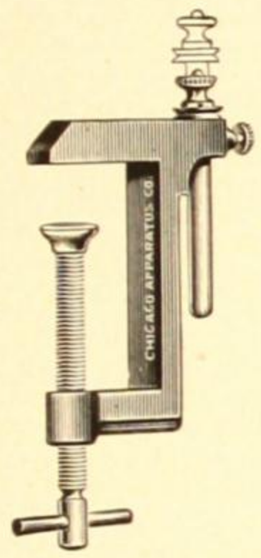
1004R. Second Law of Motion. New model. Spring with trigger release, mounted on metal platform with rod to be clamped on support stand, and two 19 mm. steel balls. Length, including rod, 25 cm. At snap of spring, one ball is released and drops in a straight line, through a hole in the platform, to the floor; at the same time the other ball is projected forward, both balls reaching the floor at the same time..**$1.25**

1006R. Second Law of Motion Apparatus, Milvay. When used on corner of table, balls drop to the floor. May also be attached to a support rod for increasing the distance to the floor, or for dropping the balls to the table top. Has new trigger release; simple tension adjustment for making the projected ball travel different distances; a 13x20 cm. rod for attaching to support rod. Very substantial—made entirely of metal. Block measures about 6.5x25 cm. **$3.00**

1007R. Steelyard, Pratt Laboratory Form. For demonstrating the principles of steelyards and levers. Consists of a steel rod 36 inches long, two clevises with suspension hooks, three sliding counterpoise weights, and pivot support. Two of the counterpoises are of equal weight while the third is half the weight. Holes are drilled into the rod at regular intervals for attaching the clevises and for supporting the bar on the pivot stand. All parts are polished and nickel-plated. Total weight about 20 lbs. Complete, but without spring balance, weight hanger, and slotted weights.....**$25.00**



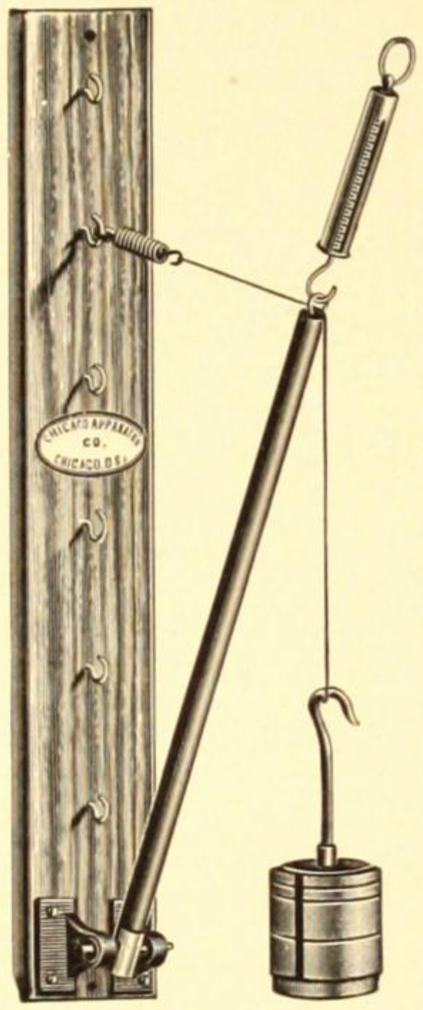
No. 1009R.



No. 1011R.



No. 1014R.



No. 1019R.

1009R. Tension Clamp, Stone's. Improved form. For use in experiments on composition of forces, resultant of concurring forces, error of spring balance, laws of the lever and other experiments in which it is necessary to maintain a strain on a wire or cord. The wires, cords, strings, etc., are securely clamped by an eccentric lever, while their tension is easily adjusted to any desired degree. Substantially made of cast iron, neatly japanned. Fits table top or board 7 cm. thick or less.....**$0.80**

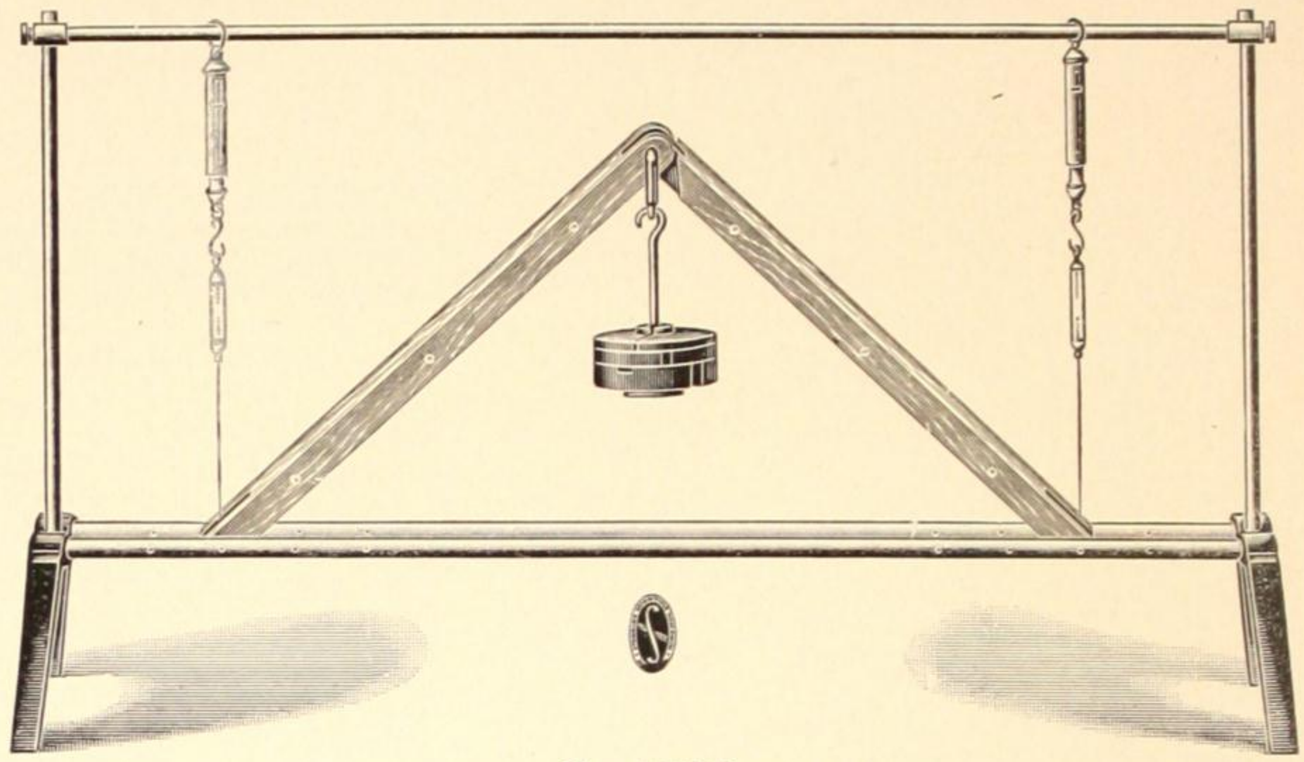
1011R. Tension Clamp, Milvay, New Adjustable Form. The old eccentric lever types have two drawbacks:

1. The tremendous leverage so easily applied cuts the string.
2. The height of the string above the table cannot be varied.

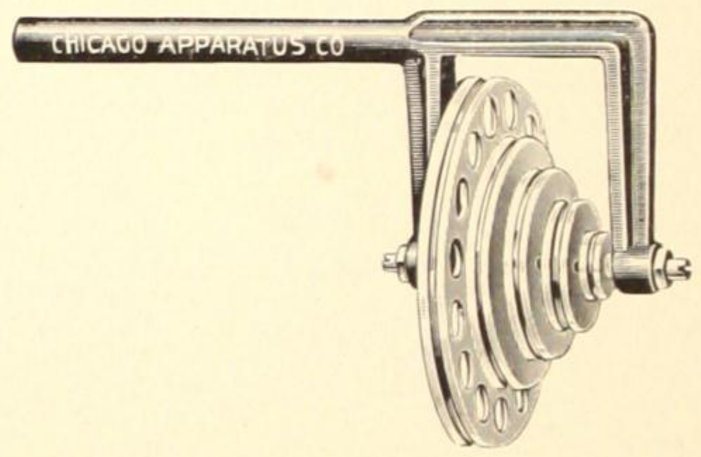
In the Milvay, the broad locking surfaces make it impossible to cut the string, no matter how much pressure is applied. The height of the string above the table can be varied through a range of 5 cm. so that it will lie parallel to the table and close to the paper. Your students will, therefore, get better results in their work on composition of forces, resultant of concurring forces, etc. The new string-locking device also affords an easier, quicker and nicer means of adjusting the tension. Made entirely of metal, finished in black enamel, fits table tops 6 cm. thick or less.....**$1.25**

1014R. Tension Screw. For applying and maintaining a strain on a wire in sonometer and breaking strength experiments. In use, the block is secured to the edge of a table or board by means of a clamp. Screw has 22.5 cm. range of adjustment and is provided with a hook at one end for fastening the wire or cord..**$1.00**

1019R. Truss, Simple. For teaching in the most direct manner possible, forces in the simple stick and tie. The angle of inclination and load may be varied at will and the component forces at each angle accurately determined. The problem becomes even more interesting when the angle is increased to 90 degrees. Mounted on neatly finished hardwood board 10x110 cm. Without balances and weights **$5.00**



No. 1017R.



No. 1024R.

1017R. Truss, Roof, Pratt Institute Design. For laboratory and lecture use. The base support consists of heavy cast-iron feet to which the two horizontal bed rods are attached. Each of the rafters, made of finely finished hardwood, measures 2x2x27 inches. They are connected by a special bronze U-shaped stirrup. The uprights and top cross rod are of steel nickel-plated and polished. This apparatus is 51 inches long and provides a simple means for determining the horizontal and vertical stress in rafters. Complete as illustrated, but without spring balances, turnbuckles, weights and weight hanger **$25.00**

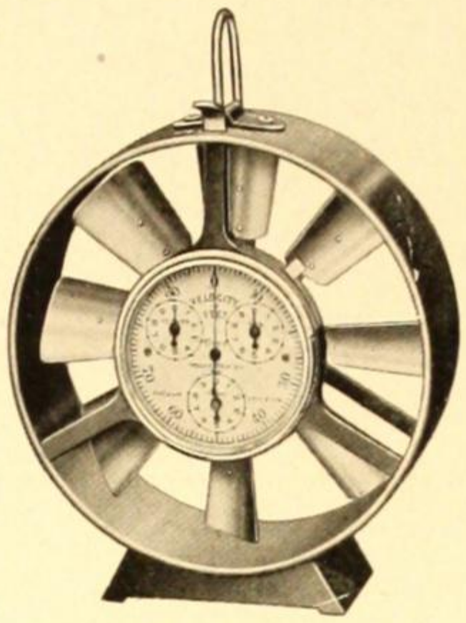
1024R. Wheel and Axle, Aluminum. For use in the study of the law of the wheel and axle. The wheel is accurately turned to five diameters—2, 4, 6, 8, 12 cm. From these diameters it is apparent that the weight arms and power arms will bear simple ratios to each other. Consequently, the weights applied at the weight and power arms will bear equally simple ratios to each other, thereby simplifying the work and making the experiment clearer to the student. Mounted in metal frame with straight rod 13 mm. diameter, for use with right-angle clamp..... **$3.00**

Meteorological Instruments

Section S



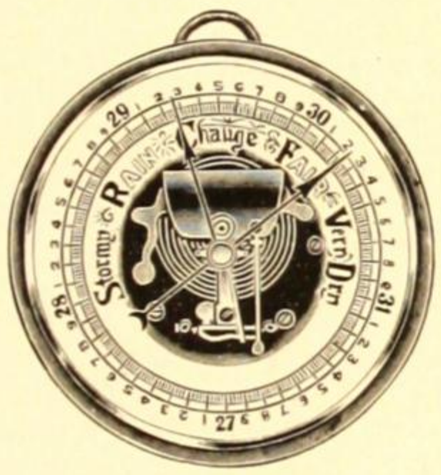
No. 1S.



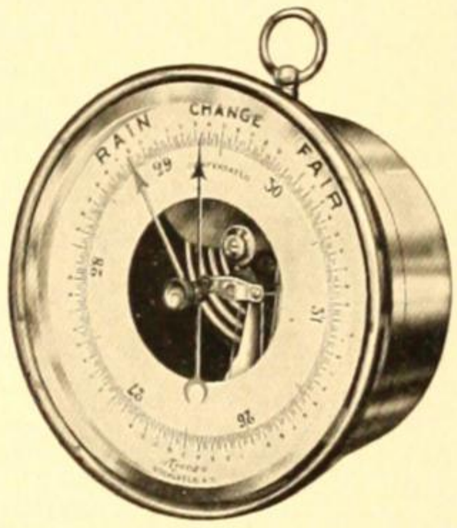
No. 2S.



No. 3S.



No. 5S.



No. 7S.

1S. Airmeter or Anemometer, Portable Type. For the measurement of ventilation of schools, hospitals, etc.; and for the air currents through mines, sewers and tunnels. Velocities are obtained by means of a delicately poised fan wheel, the recording being commenced by the long hand, which traverses the extreme outer circumference of the main dial for the passage of 100 feet of air. The enumeration is continued by a series of smaller dials. A disconnector throws the mechanism out of gear and arrests its action when required. A zero setter permits the return of all hands to zero. The pivots are jeweled, insuring accuracy and freedom from wear. Diameter of fan wheel, 2¾ inches; one large and 5 small dials recording up to 10,000,000 feet or 1893 miles; will stand pressures up to 3000 feet per minute; mounted on heavy metal base; in leather case. This portable model is particularly well suited to the needs of the laboratory and for testing school building ventilation **$64.00**

2S. Airmeter or Anemometer, Biram's. Provided with mechanism disconnector and zero setter; 4-inch diameter; 4 dials reading to 100,000 feet, largest dial reading to 100 feet in single feet; supporting feet at bottom and suspension loop at top; in neat leather case **$48.00**

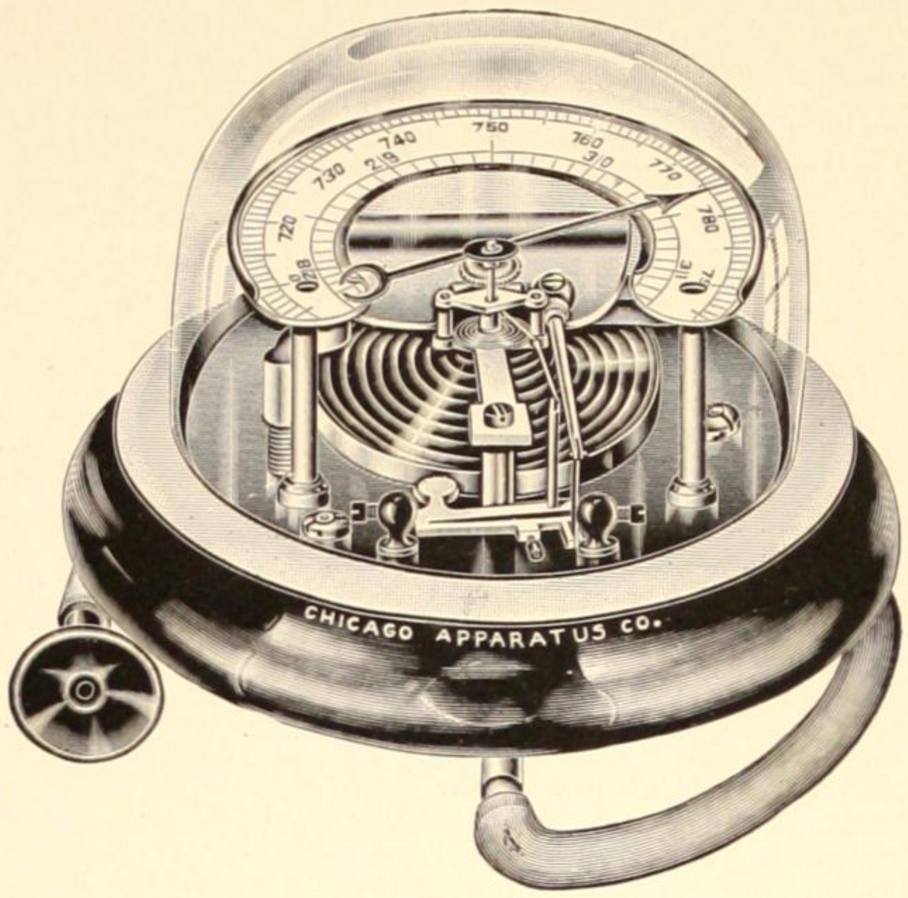
3S. Air Tester, Wolpert's. (Carbacidometer.) For determining amount of carbonic acid gas in the air. Graduated for direct readings. Complete with chemicals and directions..... **$4.50**

4S. Extra Chemicals, for No. 3S. Sufficient for six lots of solutions..... **$1.00**

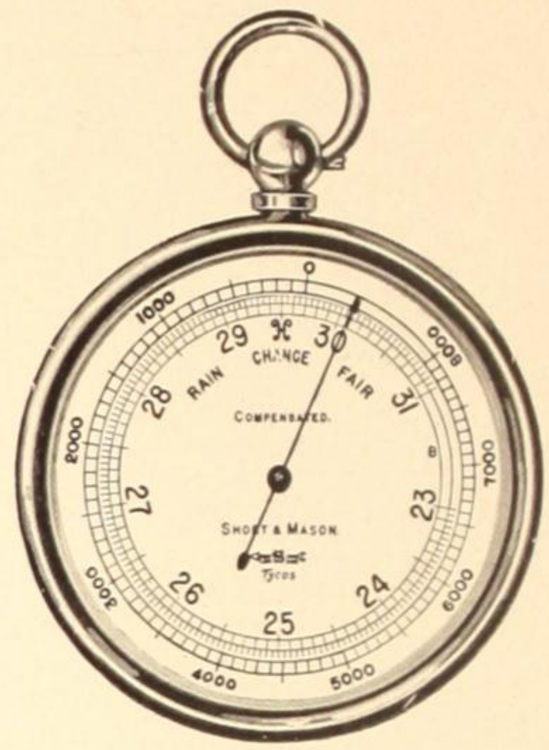
Barograph. See page 335.

5S. Barometer, Aneroid, English and Metric Scales. Diameter, 4 in.; card dial; range 27.5 to 31.5 in. and 70 to 80 cm.; nickel-plated case. Has concealed adjusting screw in back for correcting the position of the movable hand and an adjustable stationary hand for marking the last position of the movable hand. For use in all altitudes up to 3,500 feet..... **$7.50**

7S. Barometer, Aneroid. English and Metric Scales. Diameter, 5 in.; card dial; range 26 to 31 in. and from 65 to 80 cm.; brass case. Has concealed adjusting screw in back for correcting the position of the movable hand and adjustable stationary hand for marking the last position of the movable hand. For use in all altitudes up to 4,000 feet..... **$9.50**



No. 10S.



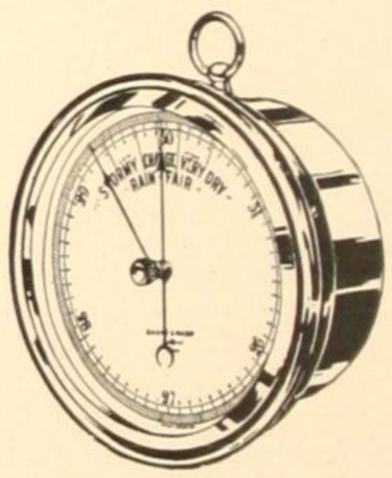
No. 12S.

10S. Barometer, Aneroid, Demonstration. A carefully constructed barometer similar to the standard form used by the U. S. Weather Bureau. The works are covered by a glass dome so as to show all working parts in their relation to each other. The instrument is sealed air-tight, the only connection being through the rubber tube. By blowing in or drawing out air, the needle may be made to change, and the action of all parts clearly seen. When not used for demonstration purposes it may be used to record barometric pressures the same as any other high-grade aneroid barometer. Is graduated in both metric and English systems. Scales range about 710 to 790 mm. and 28 to 31 inches. Diameter of instrument over all, 17 cm. for altitudes up to 3500 feet **$16.00**

12S. Barometer, Aneroid, Pocket Form (Short & Mason). A watch case instrument 1¾ inches in diameter. Scales indicate inches of mercury pressure and altitude. Altitude scale to 8,000 feet in 100-ft. divisions. Compensated for temperature change and furnished in a soft leather case. The instrument is of precise construction and can be used both as a "hill measurer" and weather indicator. Case is gold-plated and instrument weight is about 5 ounces **$25.00**

13S. Barometer, Aneroid, Pocket Form. Same as No. 12S, but with scale reading to 12,000 ft. in 100-ft. divisions **$27.00**

15S. Barometer, Aneroid, Sea Level Reading Type. English and Metric Scales. This instrument is arranged in such a manner that it is suitable for use in any location from sea level to 3,500 feet elevation. The adjustment is very simple and no rearrangement of the working parts is necessary. Once adjusted, no further adjustment is required. To adjust the barometer for your altitude, turn the brass plate set in the back of the case (this is easily done with



Nos. 15S-16S.

the fingers) until the number of feet corresponding to the elevation of your city is opposite the arrow on the case. The hand will then point to the proper mark, and the reading will be the same as that of the U. S. Weather Bureau, which is sea level reading. Spun brass base, enameled metal dial, 5 inches in diameter, good grade movement..... **$18.00**

16S. Barometer, Aneroid. English and Metric Scales. Same as No. 15S, but reading from 3,500 to 7,000 feet elevation **$21.00**

Mercurial Barometers

18S. Barometer, Experimental. Designed by Prof. John C. Packard, High School, Brookline, Mass. In use, mercury is placed in the reservoir and then pumped past the stopcock near the top of the long tube. On closing the stopcock and removing the pressure, the mercury in the long tube falls to a point corresponding to the atmospheric pressure, after which the instrument is ready for use as a barometer for practical or demonstrative purposes. Also may be used for demonstrating the principle of open manometers and of mercury gauges.

Consists of barometer tube with stopcock mounted on stand with millimeter scale and tripod base. Reservoir arranged for applying pressure on the lower mercury level, for ease in filling the long tube is provided. As illustrated, but without mercury. **$12.50**

19S. Extra Barometer Tube, with stopcock, to fit No. 18S. For replacement..... **$2.50**

30S. Barometer, Mercurial, Milvay, with Indestructible Nickel Silver Scales. Fortin principle. Features:

Scales. Deeply engraved on extra heavy nickel silver plates. Will not tarnish, corrode or wear—easier to read.

Range. 24 to 32 inches and 61 to 81.5 cm. Can be used in all places less than 5,000 feet above sea level.

Verniers. Attached to movable sight, enables readings to 1/10 mm. and to 1/100 inch.

Thermometer. High grade, calibrated in Fahrenheit and Centigrade.

Back. Mahoganized hardwood 11.5 cm. wide by 100 cm. long.

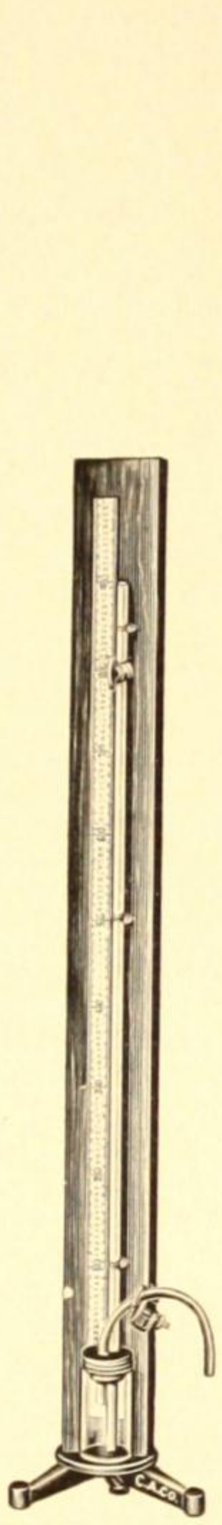
Tube. Large bore. Mercury boiled into tube to expel every trace of air and moisture. Tubes not so filled cannot indicate barometric pressures correctly.

Zero Adjuster. Same type as used in expensive Fortin Barometers. Provides a simple means for adjusting lower mercury level to zero. Barometers without zero adjuster cannot read correctly.

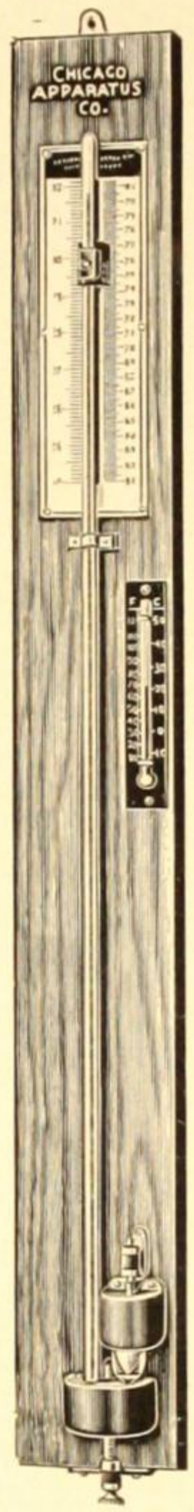
The above features and the low price made possible by quantity manufacture, make the Milvay Mercurial Barometer the best value on the market today **$35.00**

31S. Barometer, Mercurial, Milvay, High-Altitude Type. Same as No. 30S, but with scale ranges of 20 to 28 inches and 51 to 71.5 cm. For use only in places between 3,000 and 10,000 feet above sea level **$37.50**

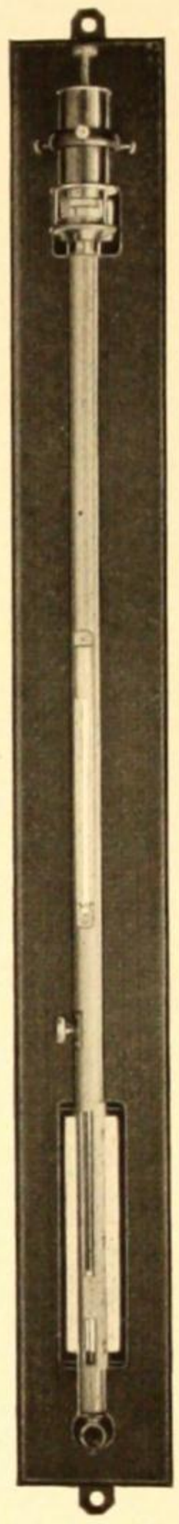
33S. Barometer, Standard Mercurial. U. S. Weather Bureau Type, Fortin Principle. Indorsed by the United States Weather Bureau and fully warranted by the manufacturer. Highest type of excellence; mercury tube enclosed in a gunmetal-finished brass body; one scale graduated in inches and tenths, the other in centimeters and millimeters; verniers enable readings to 100ths of an inch and 1/10ths of a millimeter. Vernier slider operated by rack and pinion controlled by a single milled head at upper side of tube. High grade, stem etched thermometer with Fahrenheit and Centigrade scales attached to main body tube and is easily removed for testing. Barometer reads down to 25½ inches and can therefore be used in all altitudes up to 3,500 feet. Complete with hardwood back, with suspension ring at top, and guide ring with centering screws to clamp about the cistern; and white opaque glass plates for illuminating the upper and lower mercury levels by reflected light **$85.00**



No. 18S.



No. 30S.



No. 33S.

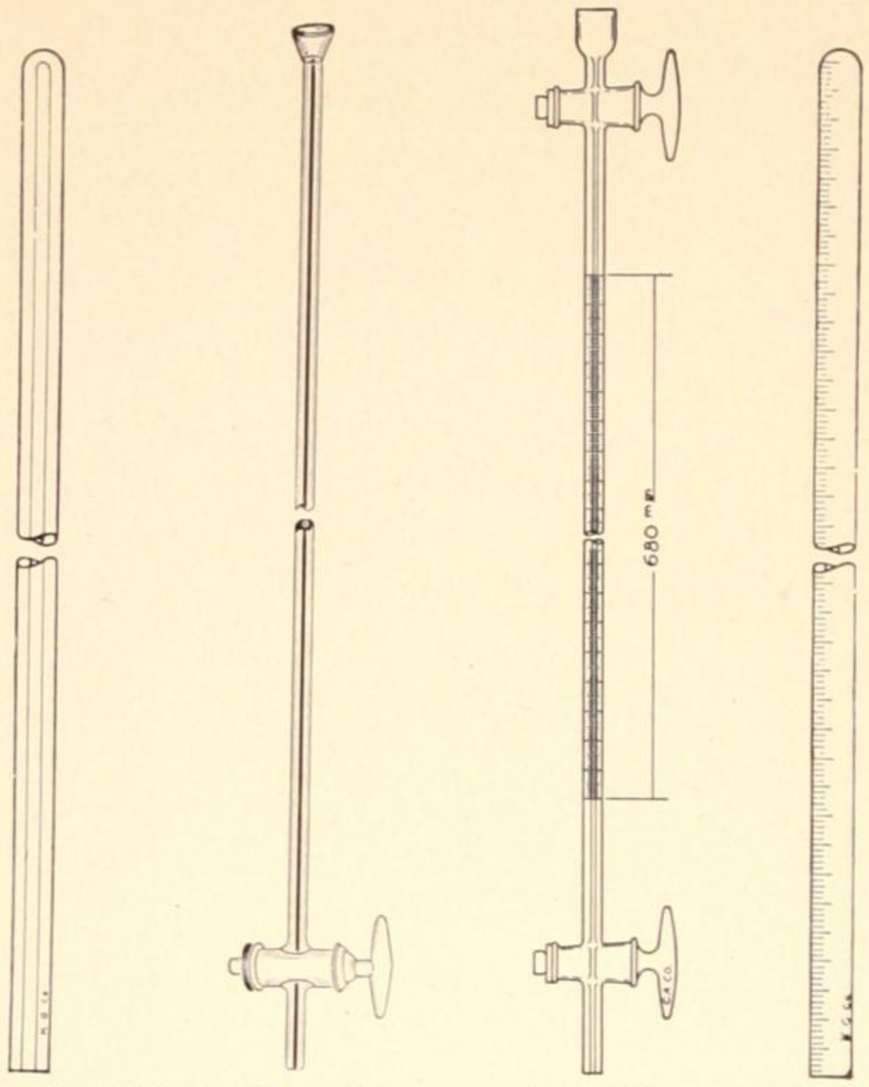
34S. Barometer, Standard Mercurial, U. S. Weather Bureau Type. Same as No. 33S, but without the hardwood back **$72.50**

35S. Back only for No. 33S Standard Barometer **$12.50**

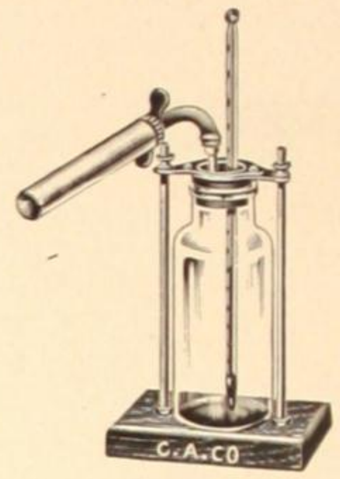
36S. Barometer, Standard Mercurial, U. S. Weather Bureau Type. Same as No. 33S, but reading down to 20 inches, for use in altitudes up to 10,000 ft.. **$110.00**

37S. Barometer, Standard Mercurial, U. S. Weather Bureau Type. Same as No. 36S, but without hardwood back **$97.50**

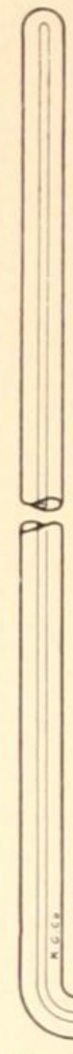
38S. Back only for No. 37S Standard Barometer **$12.50**



Nos. 55S-60S. No. 63S. No. 65S. No. 66S.



No. 85S.



No. 70S.



No. 87S.

55S. Barometer Tube (Torricellian Tube). Regular bore. Glass, unfilled, one end sealed, 80 cm. long, 7 mm. diameter, 2 mm. bore.....**$0.50**

60S. Barometer Tube (Torricellian Tube). Large bore. Glass, unfilled, one end sealed, 80 cm. long, 8 mm. diameter, 4 mm. bore.....**$0.65**

63S. Barometer Tube with Stopcock. This is a very convenient form of barometer tube or Boyle's Law Tube, because of the ease with which it can be filled. By inclining the tube and placing the open end in a cup of mercury, the thread of mercury can be drawn up the tube past the stopcock. On closing the stopcock, the mercury is trapped. If the tube is now raised to a vertical position without allowing the lower end to get out of the mercury in the cup, the column will fall to a height representing the barometric pressure, thus forming a simple experimental barometer. In preparing it for a Boyle's Law Tube, it is placed in a vertical position with the stopcock at the bottom and closed. A small amount of mercury is introduced into the open end and the stopcock opened just sufficiently to allow the trapped air to escape slowly. At the same time the mercury moves down the tube, forming the index. When the mercury index reaches the half-way point the stopcock is closed. The tube may now be used in performing the Boyle's Law Experiments described in Millikan and Gale's and other courses. Tube with stopcock, but without mercury.....**$2.50**

65S. Barometer Tube, Demonstration Form. Has funnel top and two stopcocks for easy filling and emptying. Graduated from 100 mm. to 780 mm. in millimeter divisions. Overall length, 105 cm. This tube is very convenient in lecture work, for with it a mercurial barometer can be assembled and actual readings taken—all within a few moments and before the class **$5.00**

66S. Barometer Tube, Graduated. Glass, unfilled, graduated in millimeters as illustrated.....**$2.00**

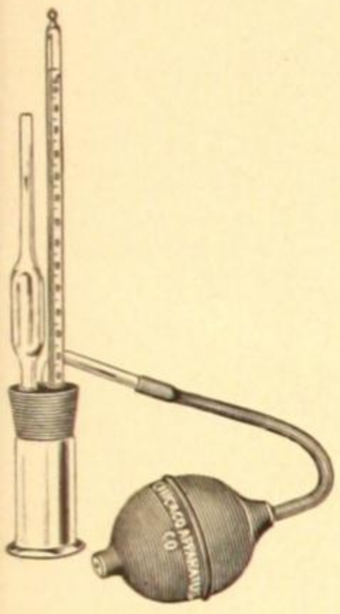
70S. Barometer Tube. Syphon Type. Glass, unfilled, with bulb on short arm, 80 cm. long, 7 mm. diameter, 2 mm. bore.....**$0.75**

75S. Barometer Tube, Syphon Type. Same as No. 70S, but filled with mercury ready for use.....**$6.00**

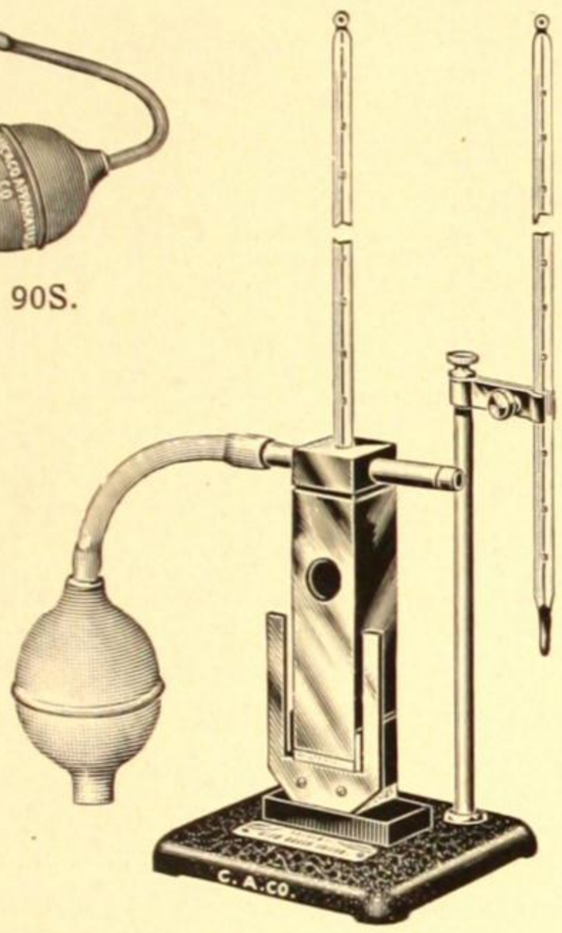
80S. Barometer Tube (Torricellian Tube). Consists of a No. 55S Barometer Tube, with porcelain mercury well, and pipette for filling.....**$0.75**

85S. Cloud Apparatus. For showing the effect of dust particles on the formation of clouds. Consists of a 16 oz. clear glass bottle, rubber stopper (clamped down) with valve, thermometer and bicycle pump mounted on hardwood support. When a small amount of water is placed in the bottle, the air compressed by means of the pump and suddenly released by pushing down the plunger of the valve, no cloud will form. If dust (smoke from burning touch paper) be introduced in the bottle and the above operations repeated, a dense cloud will form. May also be used to show that the temperature of air rises on compression and decreases on expansion. This is clearly indicated by the thermometer, the bulb of which extends into the bottle.....**$4.50**

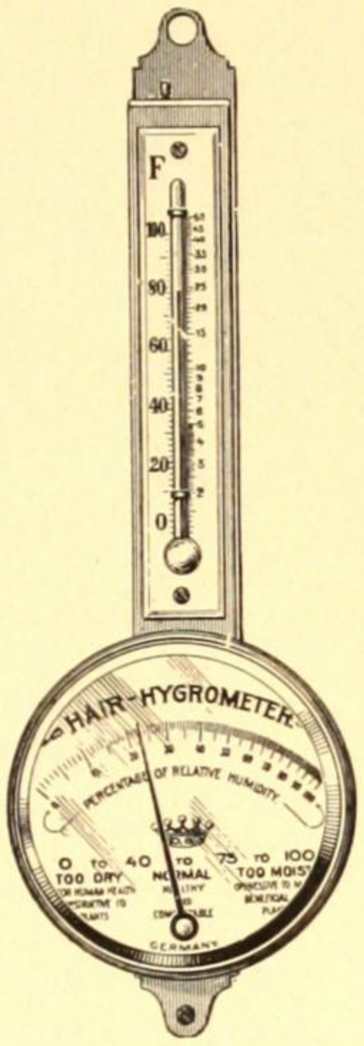
87S. Cloud Apparatus, Wilson's Simplified Form. For showing the formation of clouds on ions and dust particles by the celebrated method introduced by Prof. C. T. R. Wilson. In use the apparatus is partially filled with water. Carbon-laden air from a burning match is next drawn in through the side branch, which is then closed tight by means of the pinchcock. The rubber bulb is now compressed and suddenly released, and an opaque cloud fills the glass bulb. Repeated expansions will thin out the carbon nuclei, and finally only an occasional droplet will form. If the air in the glass bulb be ionized (by means of X-Rays or other ionizing agent), droplets will form even in the absence of other nuclei. The stem is graduated to also permit quantitative work. (See "Physics," by Duff, Lewis, Mendenhall, Carman and Knipp, 1926, page 457).....**$4.00**



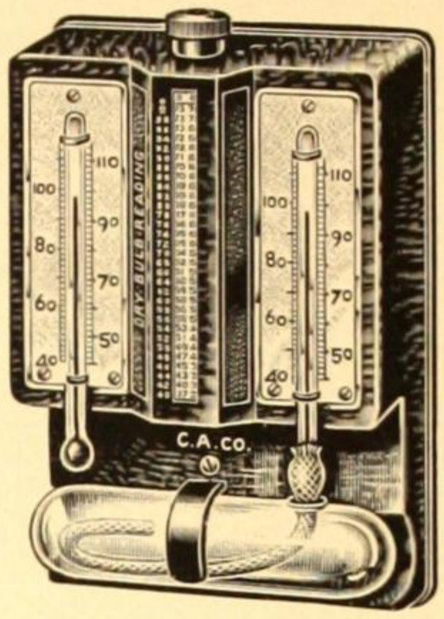
No. 90S.



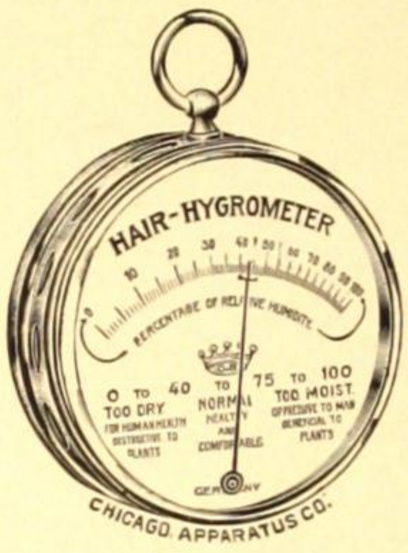
No. 93S.



No. 95S.



No. 103S.



No. 100S.

90S. Dew Point Apparatus. As used in Millikan, Gale and Bishop's Course. Consists of 28x54 mm. nickel-plated brass ether cup, three hole rubber stopper to fit, glass pipette, and rubber atomizer bulb **$1.00**

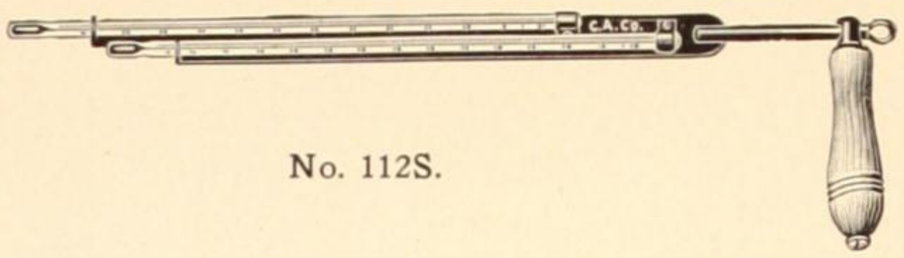
1411C. Rubber Bulb only of No. 90S..... .35

93S. Dew Point Hygrometer, Alluard's Form. This form makes possible the most accurate determination of the dew point temperature. Consists of a nickeled box with one highly polished face, immediately adjacent to which is an equally polished nickel surface upon which no dew is formed. The removable top contains three openings, one for thermometer, one for attaching the aspirator bulb, while the third serves as the outlet for the air which has been forced through the ether. Back of the ether box is a rod and clamp for supporting the thermometer used in taking the air temperature. Mounted on a metal base with proper thermal insulation for the ether box and adjacent polished surface. Including rubber aspirator bulb, but without thermometers **$12.50**

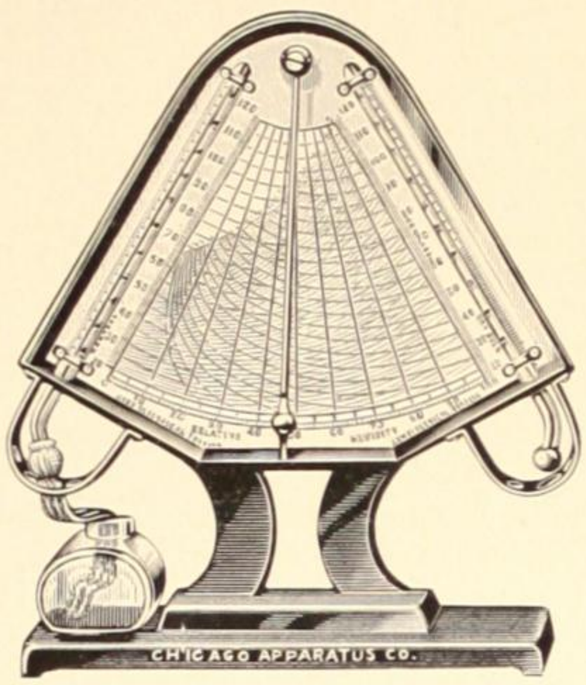
95S. Hygrometer, Hair. Scale denotes the humidity of the air without reference to tables. In brass case, 7.5 cm. dial **$10.00**

100S. Hygrometer, Hair. A high-grade, dependable instrument. Far superior to the ordinary spiral hygrometer. Indicates directly the percentage of relative humidity without reference to tables. Nickel-plated case, 8 cm. diameter..... **$6.00**

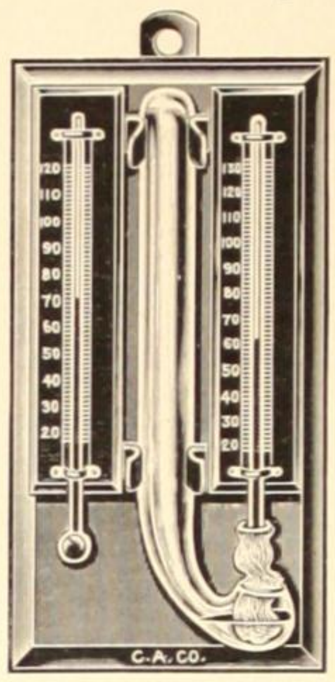
103S. Hygrometer, Humidiguide. A modified form of Mason's hygrometer. Its strongest appeal to users of this type of instrument lies in the extreme convenience of the revolving-drum humidity table—a brand new feature. To use, just observe the difference between dry and wet thermometers. Example—Dry bulb reading, 80; wet bulb reading, 60; difference, 20. Turn knob at top center until red figure 20 on drum appears. The figure on the drum opposite 80 is the percentage of relative humidity, which in this case is 29. No separate tables to consult, to get lost, or misplaced. Both thermometers read from 40 to 110° F above zero. The drum table contains relative humidity percentages for each degree difference from 1 to 20° for dry bulb readings from 40 to 100° F. The mottled brown-black bakelite molded back, with thermometer scales trimmed in gold lacquer, makes this new hygrometer an article of extreme beauty, in addition to one of great convenience and utility. A non-removable back plate contains full directions and provision for hanging. Overall size, 15x9.7 cm. Complete, with extra wick.... **$6.00**



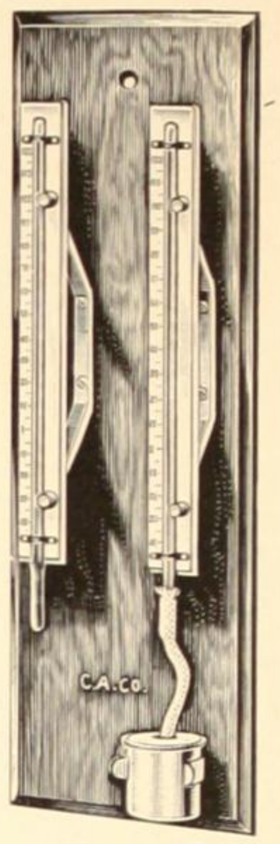
No. 112S.



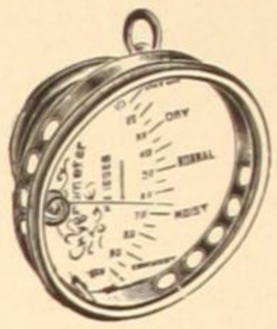
No. 105S.



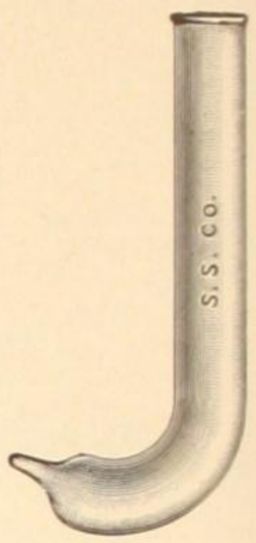
No. 110S.



No. 120S.



No. 115S.



No. 123S.



No. 124S.



No. 125S.

105S. Hygrometer (Hygrodeik). An improved form of wet and dry bulb hygrometer for determining the relative humidity, absolute humidity, dew point and foretelling frosts without any reference to tables. To find the relative humidity, swing index hand to the left of the chart and adjust sliding pointer to that degree line which corresponds with the degree of temperature indicated by the wet-bulb thermometer. Then swing the index hand until the sliding pointer intersects the curved line which extends from the degree line corresponding with the temperature indicated by the dry-bulb thermometer. At this intersection the index hand will point to the relative humidity on the scale at the bottom of the chart. Card dial, grey japanned iron frame, size 10x7¾x3 inches, engraved magnifying mercury filled thermometers, glass cistern, silk wick. Range, 20° to 120° Fahrenheit **$17.50**

106S. Extra Thermometer, Dry Bulb, for No. 105S..... **$3.25**

107S. Extra Thermometer, Wet Bulb, for No. 105S..... 3.25

108S. Extra Hygrometer Wick of Silk, for No. 105S..... .20

110S. Hygrometer, Mason's. For determining the relative humidity, absolute humidity, dew point, and foretelling frosts. Wet and dry bulb thermometer, on insulating supports, glass cistern held by metal clips, mounted on neatly finished hardwood base, 21.5x11.5 cm. **$5.00**

110Sa. Extra Cistern, for No. 110S 1.00

110Sb. Extra Thermometers, for No. 110S. Each 2.00

108S. Extra Hygrometer Wick of Silk, for No. 110S ..... .20

112S. Hygrometer, Sling Psychrometer. In whirling the bulbs, they are subjected to perfect circulation. Quicker and more accurate results are therefore possible than with the stationary wet and dry bulb forms. Consists of two specially selected thermometers, reading from about 0 to 100° F., mounted on a metal plate provided with handle and swivel. The ring fastened to the handle is for suspending the instrument when not in use **$6.75**

113S. Extra Thermometer, to fit No. 112S. For replacement. Each **$1.25**

107S. Extra Hygrometer Wick of Silk, for No. 112S..... .20

115S. Hygrometer, Spiral. Spun brass nickel-plated case, 7.5 cm. dial. Range of scale 0 (absolute dryness) to 100 (saturation). Indicates humidity of the air without reference to tables, the numbers indicating percentage of moisture..... **$3.00**

120S. Hygrometer, Weather Bureau Standard (Taylor). Consists of two No. 179S Standard Thermometers on finely finished 17x5 inch wooden board with nickel plated cistern, silk wick and manufacturer's certificates. The scales are of aluminum and are attached to protruding brackets of brass to provide ample air circulation about the thermometers. They are held in place by thumb screws and are therefore readily removable. Range—40 to 120° Fahrenheit. Recommended for indoor laboratory use and where results of dependable accuracy are required. Complete with table of humidities, directions and manufacturer's certificates **$21.00**

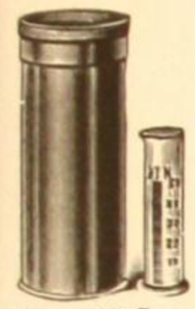
108S. Extra Hygrometer Wick of Silk, for No. 120S ..... .20

121S. Maps, Weather. Blank U. S. weather maps, 8x10½ inches, 50 in envelope. **Per package**.... **$0.60**

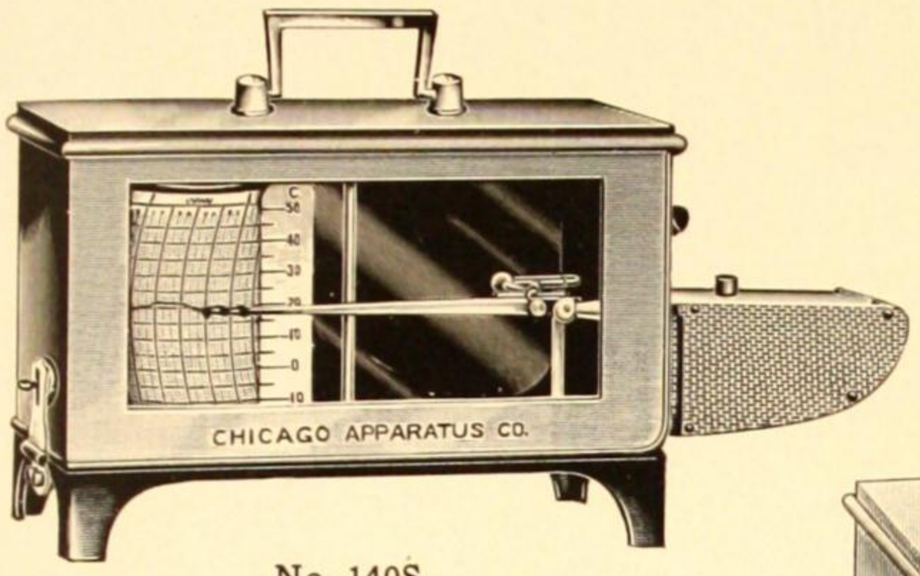
123S. Mercury Dropper. For filling manometer, barometer, and thermometer tubes. Prevents waste of mercury by spilling. Glass, about 4½ inches long **$0.35**

124S. Mercury Well and Pipette Combined, Glass. Excellent for filling barometer tubes, Boyle's law tubes, commutators, etc. The flow of the mercury, which issues from the fine top opening, can be regulated and stopped by the action of the thumb over the side opening. This new device provides the nicest, cleanest, safest and most convenient way for handling mercury. Cap., 8 ounces of mercury..**$0.75**

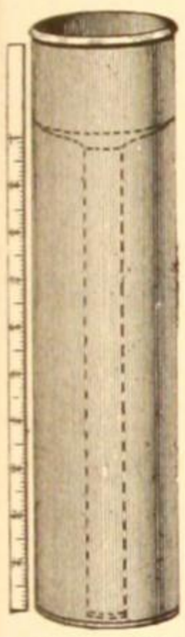
125S. Mercury Well. Iron, dead black finish. Capacity 75 cc. Will hold about three pounds of mercury. With lip (pour-out) **$0.50**



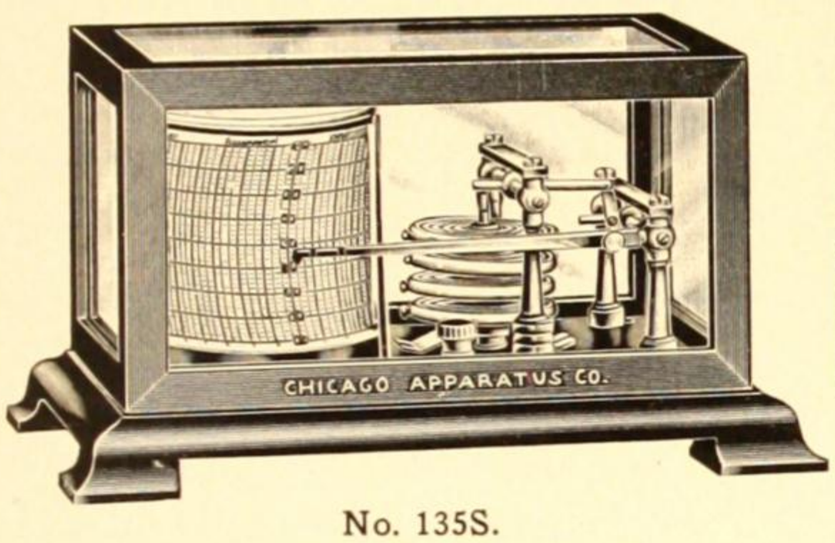
No. 130S.



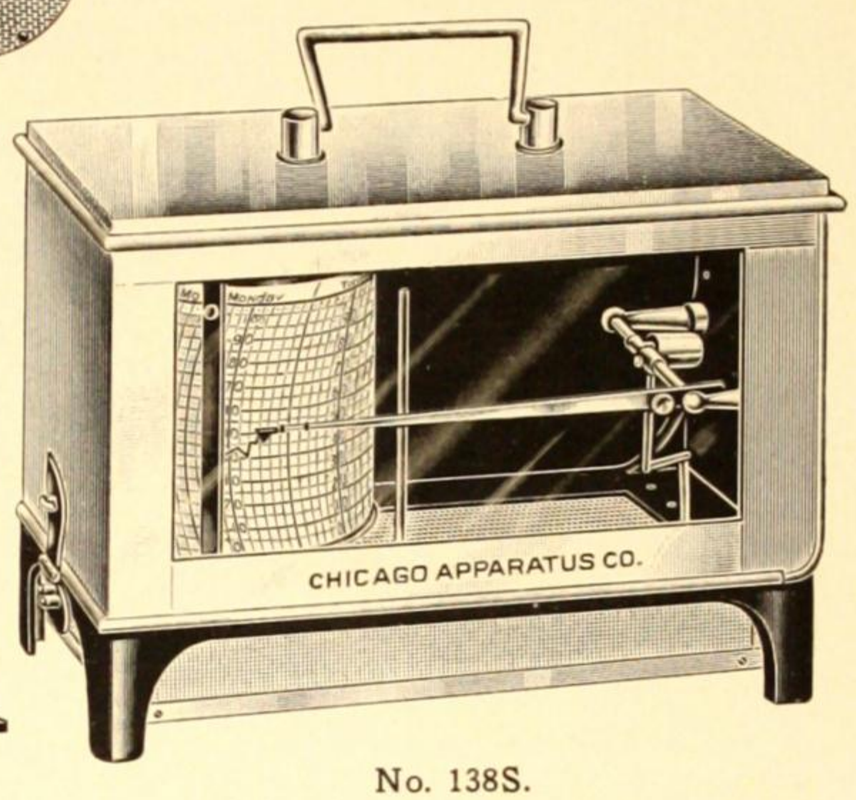
No. 140S.



No. 132S.



No. 135S.



No. 138S.

130S. **Rain Gauge. British Association Gauge.** Consists of a galvanized iron cylinder 12 inches high by 5 inches in diameter, on which copper funnel is made to fit as a cap. The interior of the cylinder contains a galvanized removable receiver and a graduated glass jar. Measures rainfall directly to 1/100 of an inch **$3.50**

132S. **Rain Gauge. U. S. Weather Bureau Pattern.** Consists of an outer 3x13 inch zinc vessel fitted with a copper funnel exactly 3 inches in diameter. The bottom of this copper funnel fits in the top of a brass tube 1 inch in diameter, in which the rain collects and is measured. This tube is provided with an overflow opening. Complete with wood rule graduated for reading the rainfall directly to 1/100th of an inch **$4.00**

133S. **Rain Gauge Rule.** Wood rule for use with No. 132S, graduated for reading the rainfall directly to 1/100th of an inch **$0.75**

135S. **Recording Barometer or Barograph.** Traces with a special pen upon a printed chart, a complete and continuous record, covering a period of one week, of the changes in atmospheric pressure. For statistical purposes the charts may be readily filed and indexed for quick reference. Vacuum chamber, recording mechanism and drum being mounted in a case with glass sides and top, are in full view. Complete with charts for a year, pen and ink..... **$60.00**

136S. **Barograph Charts.** For No. 135S. In boxes containing one year's supply. **Per box**..... **$3.00**

Note: In ordering Barograph charts, to insure fit, it is necessary to send in a sample of the kind in use.

138S. **Recording Hygrometer or Hygrograph.** In this new model the sensitive multiple hair system is placed in a perforated metal compartment in the base of the instrument, instead of an awkward, easily-injured skeleton frame, projecting from one end of the case. As a result this new model is more compact and the hair system is fully protected against injury from tampering or otherwise. This portable instrument is arranged to give a continuous 7-day ink record of the relative humidity on a chart ranging from 0° to 100°. In gray enameled case with black base. Overall size, 24.5x18x12.5 cm. Complete with ink and charts for one year..... **$65.00**

139S. **Hygrograph Charts** for No. 138S. **Per box of 55**..... **$2.50**

140S. **Recording Thermometer or Thermograph.** This portable thermograph is arranged to give a continuous 7-day ink record on a chart. The chart, with a range of 0° to plus 100° F., is divided into days and two-hour subdivisions of each day. Horizontally, the dividing lines are in degrees of temperature. The charts should be changed at the beginning of each week and at the same time the clock movement should be wound.

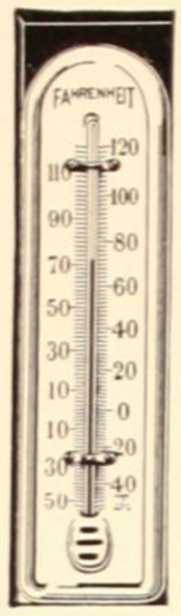
An arm carrying the recording pen is connected directly to a bimetallic coil, which changes as the temperature rises or falls. This causes the arm, with the recording pen attached, to move vertically over the chart, leaving its record.

The instrument is contained in a gray enameled metal case with a glass front over the chart and a screen protecting the movement. Furnished complete, with one year's supply of charts, bottle of ink, and full instruction **$56.00**

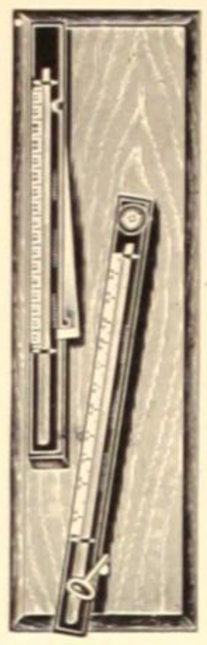
141S. **Thermograph Charts.** For No. 140S. In boxes containing one year's supply. **Per box**..... **$3.00**

Note: In ordering Thermograph Charts, to insure fit, it is necessary to send in a sample of the kind in use.

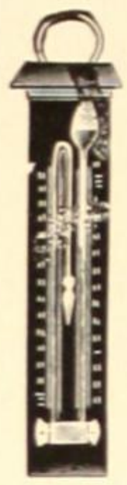
142S. **Purple Ink.** For use with recording barographs, hygrographs and thermographs. **Per bottle**.... **$0.55**



No. 147S.



No. 175S.



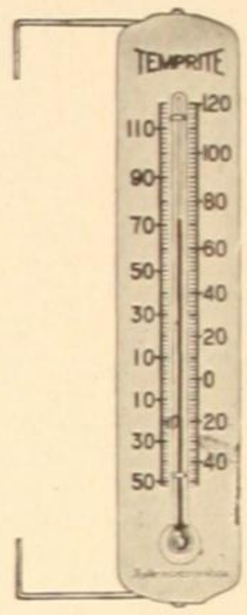
No. 176S.



No. 177S.



No. 185S.



No. 190S.

147S. Thermometer, House. New non-corrosion type for indoor or outdoor use. Porcelain enameled back in which the numerals are fired on at a temperature of 1500° Fahr. Trimmings of a solid brass, nickel-plated. Magnifying tube filled with non-fading red liquid. Range, —50 to 120° Fahrenheit. Overall length, 8 inches. This new fine appearing thermometer represents unusually good value at the low price of **$1.00**

165S. Thermometers, Registering. Minimum and Maximum. Magnifying type thermometers, 12 inches long, with black oxidized scales, mounted on an oak back. Approximate scale ranges, 20° to 60° below to 120° above zero Fahrenheit. Each tube is mounted on a separate plate attached at one end with thumb-screw so that the thermometer may be easily reset **$7.50**

175S. Thermometers, Registering. Minimum and Maximum U. S. Weather Bureau Pattern. The thermometers are stem etched and mounted on 12-inch aluminum scales, on which are marked the figures for every 10 degrees and every 5 degree line of the scale. Approximate scale range, 20° below to 120° above zero Fahrenheit. The thermometers are insulated from the wood back by being mounted on brass strips with thumb-screws. On mahoganized wood board 17x5 inches. With manufacturer's certificate for each thermometer **$18.00**

176S. Thermometer, Registering, Six's Pattern. White-enameled tin case, 10-inch boxwood scale, black-filled letters. Special horseshoe magnet for resetting. Approximate scale range, 10° to 40° below to 120° above zero Fahrenheit..... **$5.00**

177S. Thermometer, Registering, Six's. A new all-glass design, suitable for indoor or outdoor use. Mounted on 22x6 cm. beveled glass plate 7 mm. thick. Graduations and figures are of the bold distance reading type. They are under glass and protected by a white porcelain-like coating, making obliteration impossible even when exposed to the severest weather conditions. Range about —20° to 120° F. No other Six's excels this new pattern in appearance or quality. Provided with screw holes at top and bottom for mounting. Including magnet for resetting the indices **$6.00**

179S. Thermometer, Weather Bureau Standard. Same as used on No. 120S Standard Hygrometer. A 12-inch thermometer with etched stem mounted on an aluminum scale divided into 5 degree divisions and numbered every 10 degrees. This scale with thermometer is attached to a heat insulating bracket by means of thumb screws and is therefore readily removable. The bracket is also provided with two screw holes for board or wall mounting. Range about—40° to 120° Fahrenheit. With manufacturer's certificate **$8.00**

185S. Thermometer, Three Scale. Boxwood, F. R. and C. scales **$0.75**

190S. Thermometer, Window. For taking outdoor temperatures. Provided with metal brackets for attaching to either side of the window frame, and adjustable to any convenient angle. Weatherproof construction. Non-chipping white enameled scale, 8¼ inches long. Range about 50° to 120° Fahrenheit **$1.00**

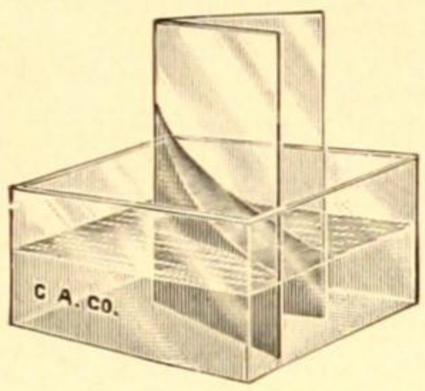
Apparatus for Properties of Matter



No. 230S.



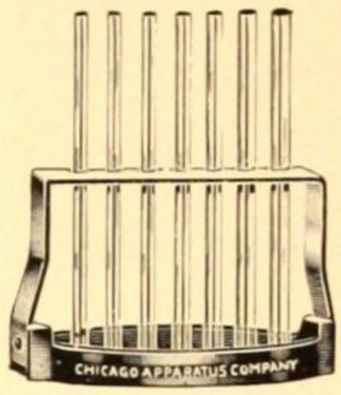
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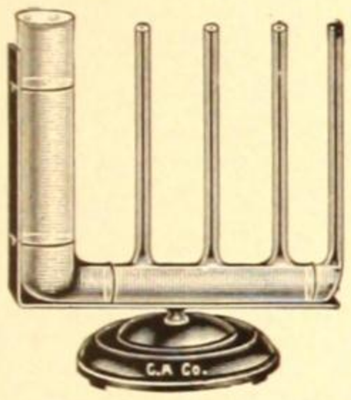
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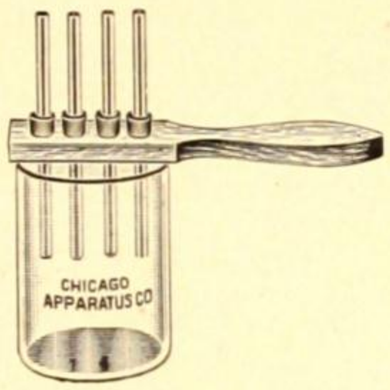
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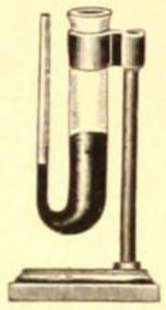
No. 250S.



No. 253S.



No. 255S.



No. 265S.



No. 270S.

230S. Brownian Movements Apparatus. For visually demonstrating the existence of molecular motions in gases in a very direct and striking way. Minute smoke particles suspended in perfectly stagnant air are ceaselessly dancing about as if endowed with life. These motions, known as Brownian movements, are revealed when match or cigarette smoke, drawn into the chamber of this apparatus, are illuminated and viewed under a compound microscope of 50 to 100 power. The haphazard gyrations of the brilliant stardust-like smoke particles are far more fascinating than the excursions of radium emanations in the largest and most powerful spinthariscope. Their particular action is the direct result of the unequal bombardment which the particles receive from the flying molecules of the gas with which they are surrounded. Any good source of light will serve for the illumination, but the best results are obtained with an arc source like our No. 512K. The apparatus is 10 cm. long and is designed for clamping to the stage of a microscope. We highly recommend this simple little device to science teachers desirous of demonstrating the molecular activity and discontinuous nature of gases **$4.50**

225S. Adhesion Disk. Glass, 7.5 cm. diameter, suspended by three cords. For illustrating adhesion between glass and a liquid..... **$0.30**

235S. Capillary Plates. For showing the capillary elevation of water between two plates inclined at a small angle. Consists of a pair of 10x12.5 cm. glass plates, with fibre strip and rubber band..... **$0.40**

240S. Capillary Scale. According to Chute. Metal scale, 10 cm. long, with zero at the tip, graduated in millimeters, for measuring capillary attraction. . **$0.50**

245S. Capillary Tubes, Glass. Set of seven, 12.5 cm. long, ¼ to 1¾ mm. bore, 6 mm. external diameter **$0.35**

250S. Capillary Tubes, Mounted. No. 245S Tubes mounted in a nickel-plated support on japanned iron water reservoir, 10 cm. long **$1.00**

253S. Capillary Tubes, Mounted. Reservoir and four capillary tubes 10 cm. long, each of different bore, sealed into a communicating tube. Mounted on neat metal stand **$1.50**

255S. Capillary Tubes, Mounted. Four glass capillary tubes, 12.5 cm. long, of different bores, mounted in a bar to rest on tumbler..... **$0.60**

260S. Capillary U-Tube, Glass. Consists of a glass U-Tube, 12.5 cm. long, one branch of which is a capillary tube. For showing the depression of mercury in a capillary tube..... **$0.50**

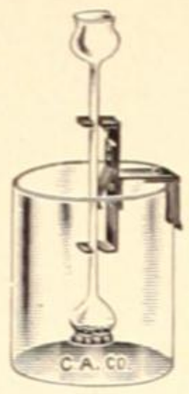
265S. Capillary U-Tube, Mounted. No. 260S U-Tube mounted on a neat metal stand..... **$1.50**

270S. Cohesion Plates, Glass. For showing cohesion between two glass plates. Plates are 7.5 cm. in diameter by 7 mm. thick, perfectly plane faces, ground edges. Provided with wood handles for ease in handling. **Per pair**..... **$0.50**

275S. Cohesion Plates, Lead. For showing cohesion between two lead surfaces. Diameter, 5 cm.; faces ground plane; plate and handle are one piece of molded metal. **Per pair**..... **$0.90**



No. 285S.



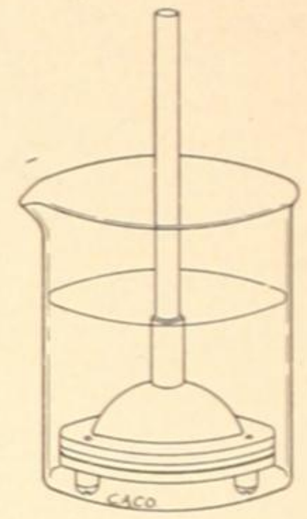
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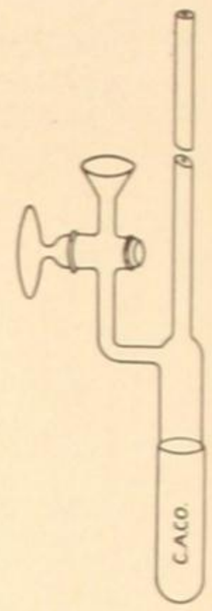
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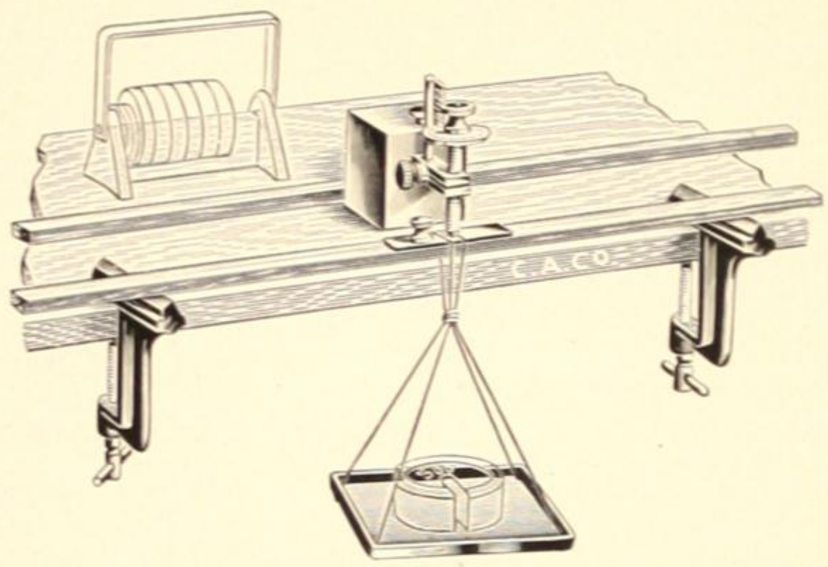
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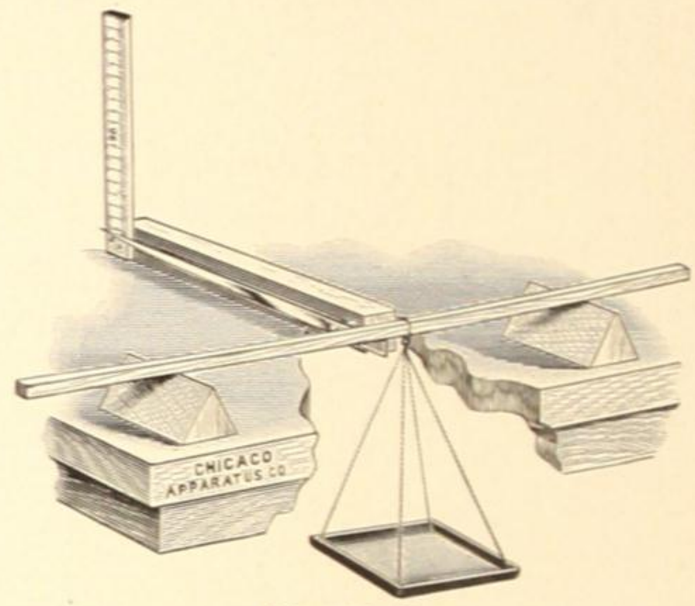
No. 315S.



No. 317S.



No. 325S.



No. 330S.

285S. Diffusion of Gases, Tube and Cup Type. For illustrating the diffusion of hydrogen through a porous cup. Consists of a glass tube, 50 cm. long, attached to a 5x10 cm. porous cup by means of a rubber cap **$0.70**

293S. Diffusion of Liquids. Double Thistle Type. For students' use for illustrating osmosis qualitatively or quantitatively. Glass tube with thistle-shaped ends (one end covered with membrane) supported in an ingenious metal clamp which fits the edge of any ordinary battery jar. Without jar **$2.00**

295S. Diffusion of Liquids. Jar and Funnel Type. For showing the diffusion of acidulated water placed in the bottom of a jar containing a blue litmus solution. Consists of a 20x4 cm. hydrometer jar and a 30 cm. funnel tube **$0.90**

300S. Diffusion of Liquids. Tube and Membrane Type. For illustrating the diffusion of a glucose or sugar solution through a porous membrane. Consists of a glass tube, 50 cm. long, with porous membrane attached. Without stand and jar.... **$0.50**

310S. Membrane. Same as used in No. 300S, without glass tube **$0.20**

315S. Diffusion of Liquids. Lyon's Osmometer. For showing diffusion of liquids through porous membranes. A semi-spherical hollow brass casting 7.5 cm. diameter, with flange and rubber washer at bottom and a hole at the top which passes through a short nipple. When a membrane is stretched across the bottom and held water-tight by the rubber washer, and a glass tube attached to the short nipple by means of rubber tubing, the apparatus is ready for use. By placing it in a dish of liquid any of the ordinary experiments on osmosis may be performed. Without glass tube or membrane..... **$1.50**

317S. Osmotic Pressure Tube. As suggested and used at the University of Chicago. Consists of a 5-foot glass tube of small bore with sidearm with stopcock and funnel tube. Complete with 3 diffusion shells (No. 857C) for attachment to lower end..... **$5.00**

325S. Elasticity of Flexure, Contact Type. Gives more accurate results than the lever method. Consists of one No. 350S Pine Rod, one No. 355S Pine Rod, two No. 365S Knife Edge Clamps, one No. 370S Scale Pan, one No. 378M Micrometer Screw and one No. 364S Contact Piece with Binding Post **$11.00**

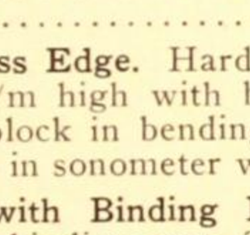
330S. Elasticity of Flexure Apparatus, Lever Type. For studying the laws of bending beams. Consists of one No. 350S Pine Rod, one No. 355S Pine Rod, two No. 360S Wood Prisms, one No. 340S Indicator and Scale, and one No. 370S Scale Pan... **$1.65**



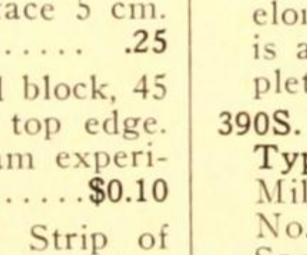
No. 395S.



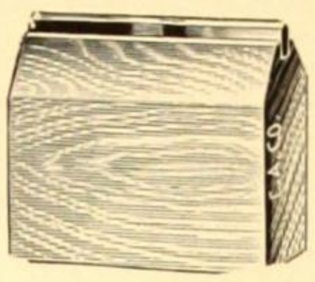
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No. 365S.



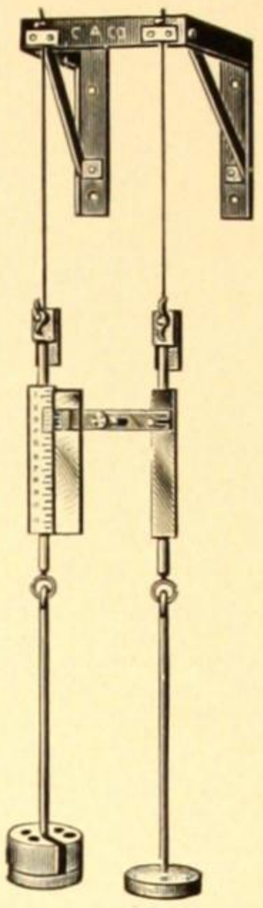
No. 367S.



No. 362S.



No. 405S.



No. 387S.

340S. Indicator and Scale. A compact unit superior to the separate indicator, prism, and mounted scale usually used with bending beam apparatus. Consists of a 20 cm. scale, graduated in millimeters, and an aluminum indicator 35 cm. long, mounted on a suitable wood base. The pivot is so placed that the ratio of the long arm to the short arm of the indicator is 6 to 1 ..... **$1.00**

343S. Brass Rod. 102x1x1 cm. 1.50

345S. Maple Rod. 102x1x1 cm. ..... .25

350S. Pine Rod. 102x1x1 cm. ..... .25

355S. Pine Rod. 102x2x1 cm. ..... .25

357S. Steel Rod. 102x1x1 cm. ..... .60

360S. Prism. Of hardwood, 10 cm. long, face 5 cm. wide ..... .25

362S. Prism With Brass Edge. Hardwood block, 45 m/m long and 40 m/m high with brass top edge. Useful as a support block in bending beam experiments and as a bridge in sonometer work..... **$0.10**

364S. Contact Piece with Binding Post. Strip of metal 1 cm. wide, with binding post. To be placed on a wooden flexure rod and under the micrometer screw so that precise settings of the latter may be made by the electric contact method..... **$0.25**

365S. Knife Edge Clamp. A metal prism 8 cm. long, provided with clamp. Fits table top 6.5 cm. or less in thickness. Superior to a wood prism. Will hold its edge. Will support rods beyond edge of table top; weight pan can therefore be suspended without boring hole through top of table..... **$0.75**

367S. Scale, Mounted. Upright graduated for 10 cm. in mm., metal base..... **$0.35**

752R. Scale Pan. Japanned metal, 12x12 cm., with suspension cords **$0.30**

375S. Elasticity of Flexure Apparatus. As used in Millikan, Gale and Bishop's Course. Consists of one No. 380S Steel Rod, a pair of No. 385S Support Blocks, one No. 395S Mirror Scale and one No. 400S Spring and Weight Holder (without weights) **$3.50**

380S. Steel Rod Only, of No. 375S. Length, 120 cm.; diameter, 4 mm. **$0.10**

385S. Support Blocks Only, of No. 375S. Wood, 6x6x19.5 cm. **Per pair** **$1.25**

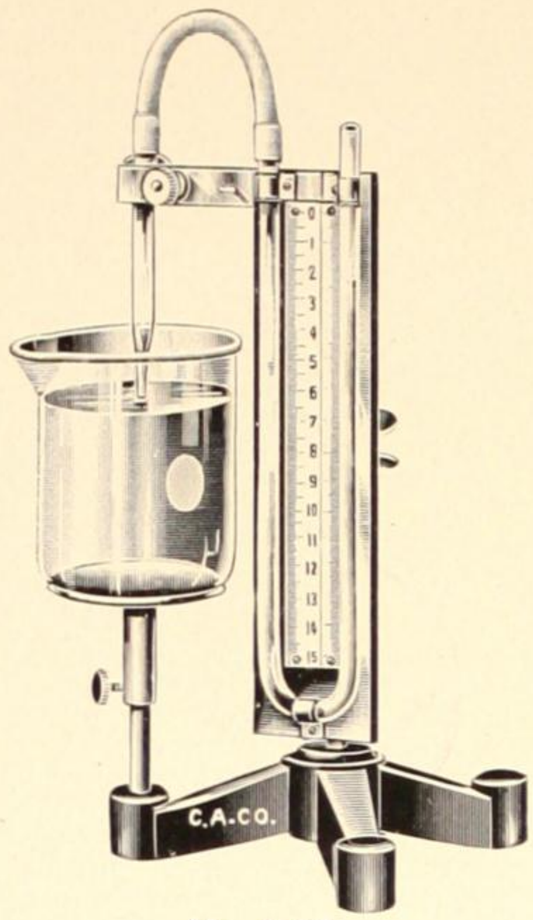
387S. Hooke's Law and Young's Modulus Apparatus. For verifying Hooke's Law and determining Young's Modulus. Improved design, after Ames and Bliss. Consists of a bracket supporting two brass wires, one of which is provided with a metal millimeter scale and the other with a vernier, by means of which elongation may be measured to $\frac{1}{10}$ mm. Each wire is also furnished with 1-kilo weight hanger. Complete with four extra 2-kilo slotted weights.... **$20.00**

390S. Hooke's Law Apparatus, Millikan and Gale Type. Elasticity of stretching apparatus as used in Millikan, Gale and Bishop's Course. Consists of one No. 395S Mirror Scale, mounted, and one No. 400S Spring and Weight Holder (without weight)... **$1.75**

395S. Hooke's Law Mirror. New Indestructible Form. The nickel-silver mirror scale, graduated for 15 cm. in millimeters, is adjustably mounted on a metal stand. Far superior to the old style glass mirror **$1.50**

400S. Hooke's Law Spring and Weight Holder. Provided with indicator. Spring elongates about 2.5 cm. per 100 gram load. Weight holder fits No. 301B Slotted Weights and has a capacity of about 500 grams **$0.25**

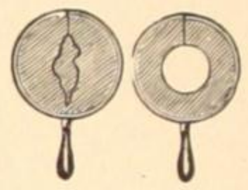
405S. Prince Rupert Drops. Pear-shaped drops of glass with long stems. In the making, these drops are suddenly cooled, leaving the glass under a great strain. Breaking the stem relieves the strain, causing the drop to crumble into powder.
Per package of 12 drops..... **$0.60**



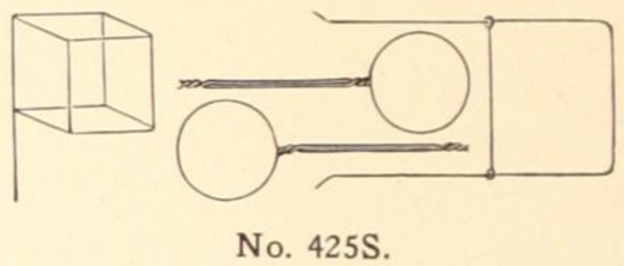
No. 412S.



No. 410S.



No. 415S.



No. 425S.

410S. Surface Tension Apparatus. For showing the surface tension in a water film. Consists of a wire ring, 6.5 cm. in diameter, mounted on a wire holder to which a cork float and a metal weight is attached. The adjustment of the float and weight is such that the ring is ordinarily held above the water. However, when entirely immersed the ring is held under by the water film **$0.70**

412S. Surface Tension Apparatus, Manometer Form. For measuring the surface tension of water, alcohol and other liquids by determining the pressure required to force the liquid back down the capillary tube. (See Exp. 6, "Physical Measurements, Part 1, Heat, Mechanics and Properties of Matter," by Ralph S. Minor, PhD., Prof. of Physics, University of California.)

In use, a beaker containing water, at room temperature, is raised on the adjustable stand until the end of the capillary just touches the liquid. Water is then introduced into the open arm of the manometer until the liquid that has been drawn up into the capillary is just driven back to the bottom of the drawn-out tube. The difference in the height of the water levels in the two arms of the manometer is then noted. The surface tension is calculated by using the equation:

$$T = \tfrac{1}{2}\, r\, d\, g\, h$$

where r is the radius of the bore of the capillary tube in cm. as determined by aid of a measuring microscope; h, the difference in heights of the water levels in the arms of the manometer; g, the acceleration of gravity (approx. 980 cm. per sec.); d, the density of water.

It is evident that the experimental procedure is extremely simple. Then, too, the results are excellent, hence the growing popularity of this form of surface tension apparatus.

The capillary tube as furnished has a bore of about .03 to .04 cm. diameter. Students can also draw their own capillaries, thereby making the experiment still more interesting and individualistic.

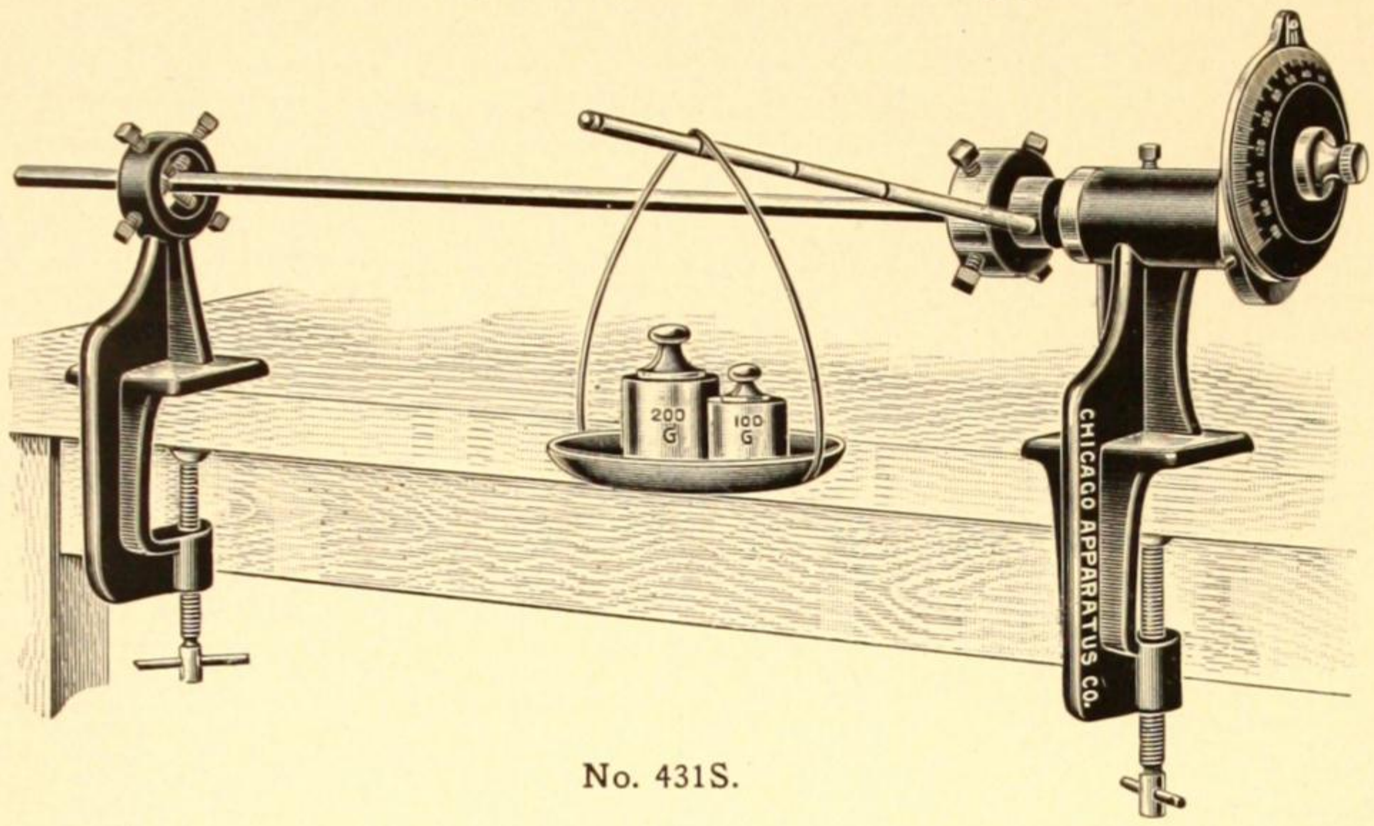
The apparatus is adjustably mounted on a heavy iron tripod, and every part is finely finished. Complete as illustrated, but without beaker..... **$9.00**

415S. Surface Tension Frame. For showing the contractibility of soap films. Consists of a wire ring, 2.5 cm. in diameter, with a looped thread of unspun silk. Mounted on wood handle, 12.5 cm. long... **$0.50**

420S. Surface Tension Frame. According to Chute. For use in the study of phenomena of surface tension in soap films. Consists of a 5x10 cm. wire frame with an adjustable cross wire. Frame is provided with handle, 9 cm. long..... **$0.40**

425S. Surface Tension Frames. For use in the study of the phenomena of surface tension in soap films. Four wire forms as illustrated. The cube measures 5x5x5 cm., the rings are 5 cm. in diameter, and the rectangle 5 cm. wide. Including clay pipe for making bubbles (spherical films)..... **$1.00**

Milvay Improved Torsion Apparatus



No. 431S.

431S. Torsion Apparatus, Milvay Improved Design. For studying the moments of forces, and determining the laws of torsional elasticity, and the coefficient of torsional rigidity of various rods.

This is an entirely new design which embodies a number of very desirable improvements. Instead of applying the load at the circumference of a wheel it is hung on a nearly horizontal lever arm provided with notches 10, 15, 20 and 25 centimeters from the center.

The load may be conveniently applied by Universal Hook weights or ordinary weights placed in the pan. In setting up the instrument the rod is clamped so that with no load attached the lever arm is about 10° above horizontal. This permits a maximum torsion of about 20° or 100 divisions on the dial.

The torsion head consists of a bicycle hub mounted in a table clamp and provided with a socket with four set-screws for clamping the end of the rod. In this head is also a pair of gears with a 5 to 1 ratio, so that a 10° twist reads 50° on the dial.

The reading device is a black 3¼-inch dial graduated for 180° in 2° divisions, with white lines. Since it is possible to read with accuracy less than half a division, the actual results are better than those obtained with the former scale and vernier device.

The dial is held in place by friction and may be readily adjusted to zero.

Advantages

1. The readings are made much more quickly and accurately than with vernier.
2. Adjustment to zero is much easier.
3. By hanging the same load successively on the different notches the fact that the angle of torsion is proportional not to the force, but to the moment of the force of torsion, is very plainly brought out. In fact, one of the most important uses of the instrument is to make clear the subject of moments in machines.
4. The wide range of load made possible by the use of the notched lever arm makes it easy to secure suitable readings for rods of many sizes and lengths.

Without a test it is difficult to appreciate how great an improvement this instrument is over previous forms.

The table clamps fit any table top of 6 cm. or less in thickness. The rods are firmly held by four set-screws in each support. A scale pan weighing 50 grams is provided. Complete with 8 rods, all 110 cm. long, as follows: One round brass rod, 6 mm. diameter; one square brass rod, 6 mm. diameter; one round steel rod, 6 mm. diameter; one square steel rod, 6 mm. diameter; one round maple rod, 10 mm. diameter; one square maple rod, 10 mm. diameter; one round whitewood rod, 10 mm. diameter; one square whitewood rod, 10 mm. diameter **$27.50**

Extra Rods for No. 431S Torsion Apparatus

435S. Brass Rod, Round, 110 cm. long, 3 mm. diameter **$0.20**

436S. Brass Rod, Round, 110 cm. long, 6 mm. diameter **$0.50**

437S. Brass Rod, Square, 110 cm. long, 6 mm. square **$0.65**

438S. Maple Rod, Round, 110 cm. long, 10 mm. diameter **$0.15**

439S. Maple Rod, Square, 110 cm. long, 10 mm. square **$0.15**

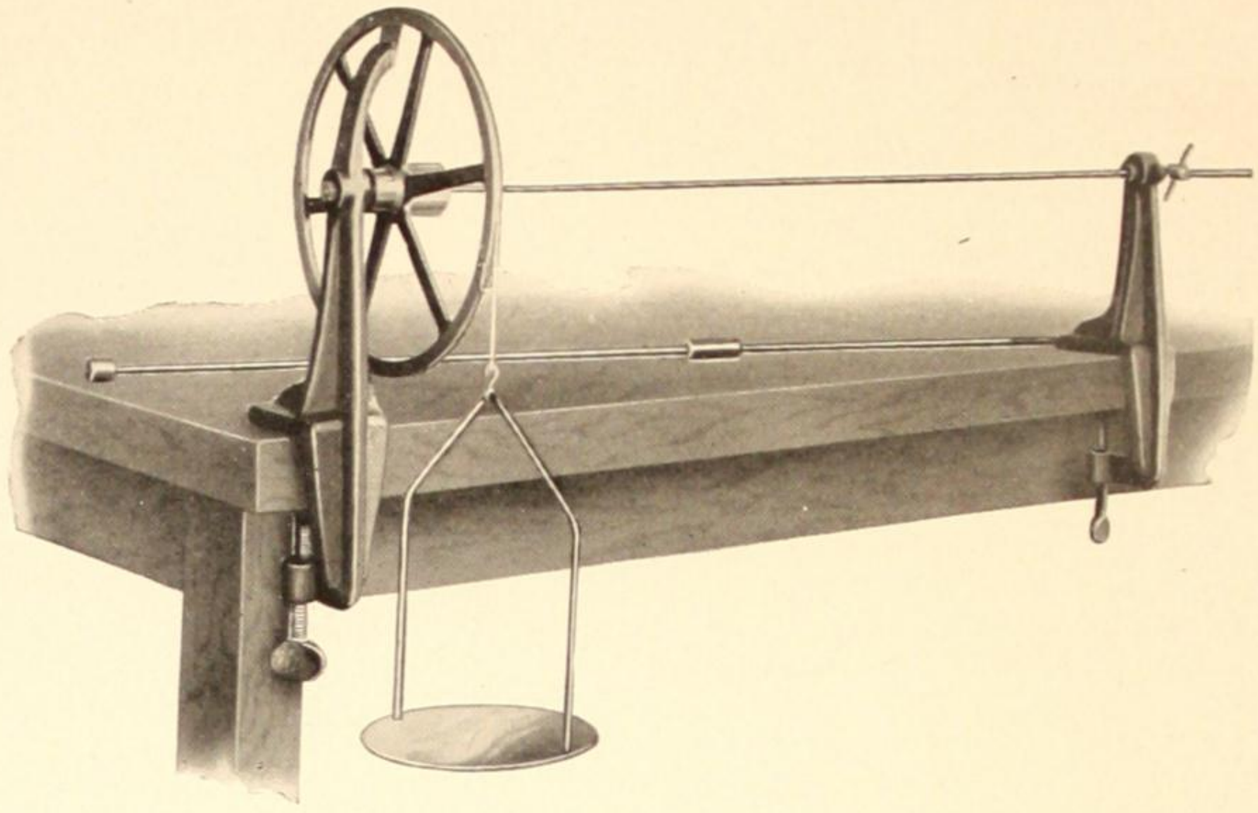
440S. Steel Rod, Round, 110 cm. long, 3 mm. diameter **$0.11**

441S. Steel Rod, Round, 110 cm. long, 6 mm. diameter **$0.20**

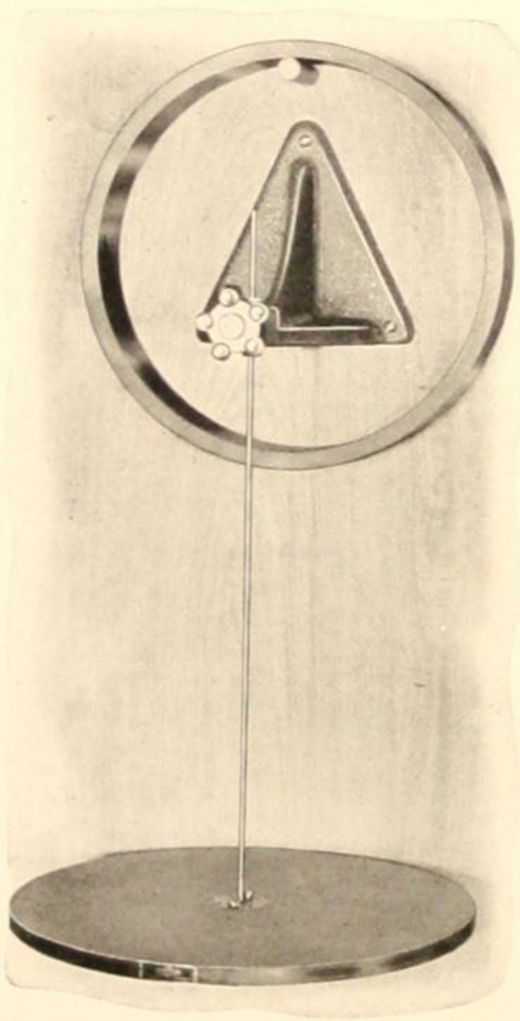
442S. Steel Rod, Square, 110 cm. long, 6 mm. square **$0.25**

443S. Whitewood Rod, Round, 110 cm. long, 10 mm. diameter **$0.15**

444S. Whitewood Rod, Square, 110 cm. long, 10 mm. square **$0.15**



No. 450S.



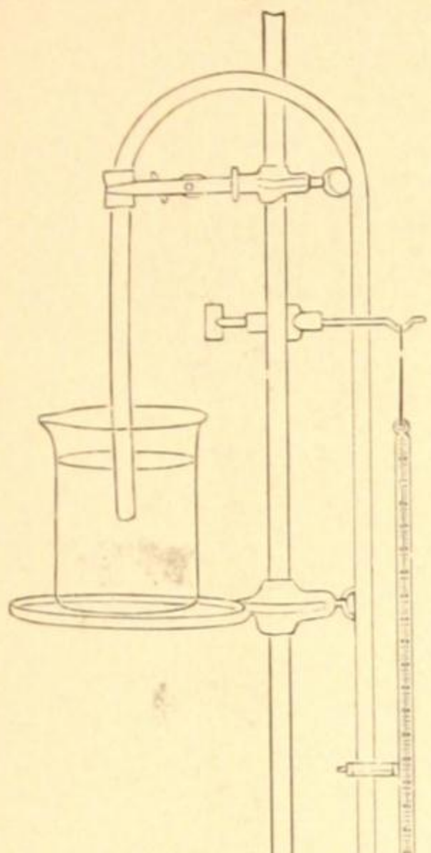
No. 455S.

450S. Torsion Apparatus. Designed for verifying Hooke's Law of Torsion and for determining the Coefficient of Rigidity and the Moment of Torsion of different rods. It is especially adaptable to Taylor, Watson & Howe's Exp. No. 10, Millikan's Exp. No. 9, and Shannon and Macelwane's Exp. No. 20.

The apparatus consists of two substantial table clamps, one of which is fitted with a ball bearing axis which carries a torsion wheel 20 cm. in diameter, graduated in degrees, 90° each way from zero. The wheel is fitted with a vernier graduated to read to $\frac{1}{10}$th degree. The torque is applied by weights placed on a pan which is attached by means of a thin, flexible metal ribbon to the flat edge of the wheel. The clamping arrangement consists of a slotted bushing permanently attached to one end of the rod which fits into the hub of the torsion wheel and is firmly held in place by a clamp screw. The second table clamp carries a split steel chuck which likewise rigidly clamps and centers the rod at any desired length which can be accurately measured. The decided advantage of this clamping arrangement is the automatic centering, total elimination of slip as well as a safeguard against the damaging of the rod surface by direct contact with the clamping screws. It also permits an accurate length adjustment of the part of the rod to be tested. Complete with two steel rods, 2 and 4 mm. in diameter, 120 cm. long, fitted with bushings.....**$30.00**

455S. Torsion Pendulum. This apparatus in connection with the Torsion Apparatus is very desirable from the pedagogical standpoint for showing the relation between the Period of Oscillation of Torsion Pendulum, the Moment of Torsion, and the Moment of Inertia, as described in Taylor, Watson & Howe's Exp. No. 11, Millikan's Exp. No. 11, Shannon and Macelwane's Exp. No. 21, and Ames and Bliss' Exp. No. 28.

The rod of which the Moment of Torsion has been previously determined by 450S Torsion Apparatus (above) is rigidly clamped at any length desired by a split steel chuck and a clamp screw fitted in a heavy wall bracket. To the other end of the rod a slotted bushing is permanently attached, which can readily be clamped onto a heavy iron disc, 30 cm. in diameter and 1.2 cm. thick. The disc is very carefully machined, avoiding any irregularities, consequently enabling reliable calculation of the Moment of Inertia from its geometrical measurements. A heavy inertia ring of the same outside diameter is furnished with the apparatus, permitting two sets of data for the same length of rod. All parts are neatly finished in dull black enamel. Complete with two steel rods 2 and 4 mm. in diameter, 120 cm. long, fitted with bushings **$27.00**



No. 484S.

Nos. 480S, 481S and 137H, etc., assembled for use.

Viscosity Apparatus

For determining the viscosity of a liquid by measuring its rate of flow through a capillary tube of uniform circular cross-section. See R. S. Minor's "Physical Measurements, Part I, Heat Mechanics and Properties of Matter."

The complete apparatus, illustrated above, is readily assembled from the three items listed below plus items with which practically every laboratory is stocked.

The pressure difference, p, in dynes per cm^2., between the ends of the tube is calculated from measurements made by means of the double manometer. The volume of flow per second, V, is determined by weighing the quantity of liquid which overflows from the lower cup in an observed time interval. The length of the capillary tube, l, may be measured with any good metric scale. Its radius, r, may be determined by means of a measuring microscope, or it may be calculated from the length and weight of a column of clean mercury introduced into the bore of the tube. The temperature, T, is determined by observing the thermometer suspended in the upper cup. The final result is calculated from the simplified formula.

$$\text{Coefficient of Viscosity} = \frac{\pi r^4 + p}{8\ V\ l}$$

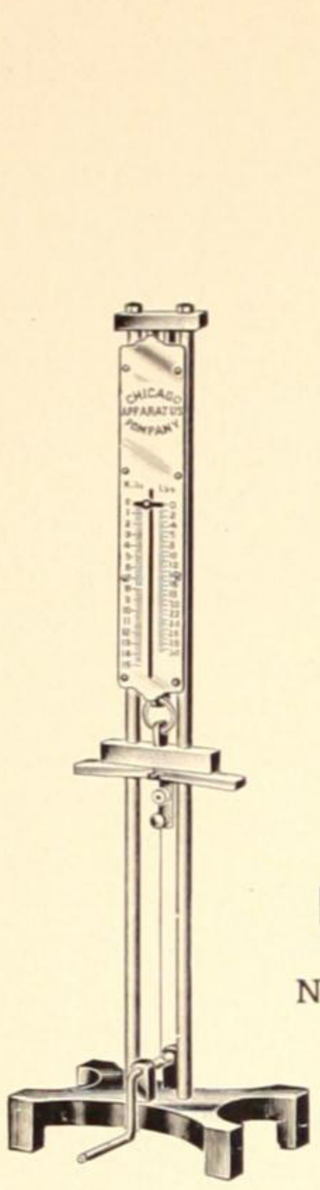
By repeating the experiment with tubes of different dimensions, the relation between viscosity and length and diameter becomes clearly established.

480S. Capillary Tube. For use in the assembly of viscosity apparatus illustrated above. Selected grade, length about 25 cm. **$1.00**

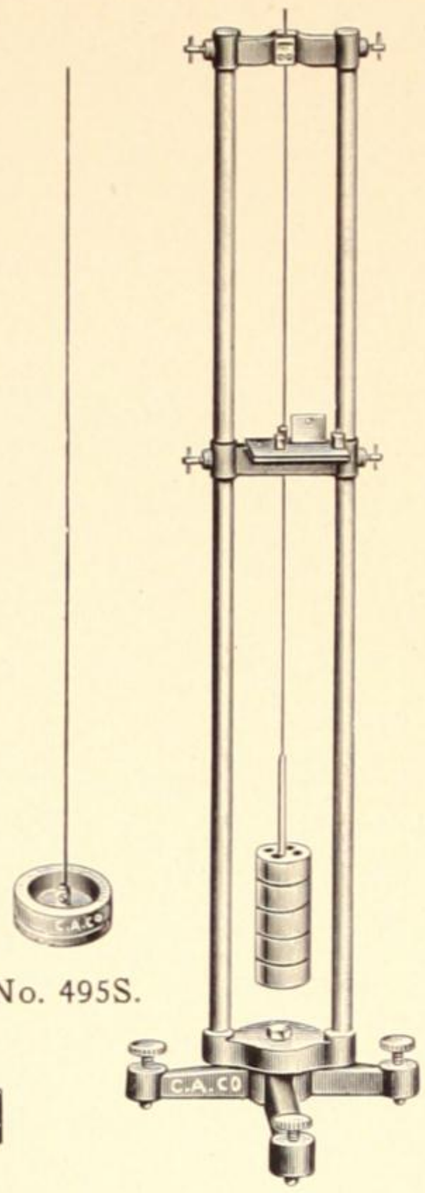
481S. Double Manometer. For use in the assembly of viscosity apparatus illustrated above. The scale is 12 cm. long, graduated in mm. and mounted on metal back with friction clamp for easy and quick height adjustment. Complete with support.... **$6.00**

137H. Constant Level Water Tank. For use in the assembly of viscosity apparatus illustrated above. Provided with inlet, outlet and overflow tube, all corrugated for rubber tubing. Diameter 7.5 cm.; height 10 cm., clamp fits 13 mm. support rod. Made entirely of brass and finished in dull black. (Two required.) **Each** **$4.50**

484S. Viscosity Pipette, Ostwald. For determining the viscosity of liquids by ascertaining the rates at which definite and equal volumes will flow out of a bulb through a capillary tube and comparing them with the rate of a standard liquid such as distilled water. The pipette is 21.5 cm. long and the section between the upper and lower bulbs is a small bore or capillary tube. The liquid under test is introduced to the lower bulb through the large tube and transferred to the upper bulb by suction. Water empties the upper bulb in 80 to 100 seconds. See "Practical Physical Chemistry," by Findlay, (1923). **$1.50**

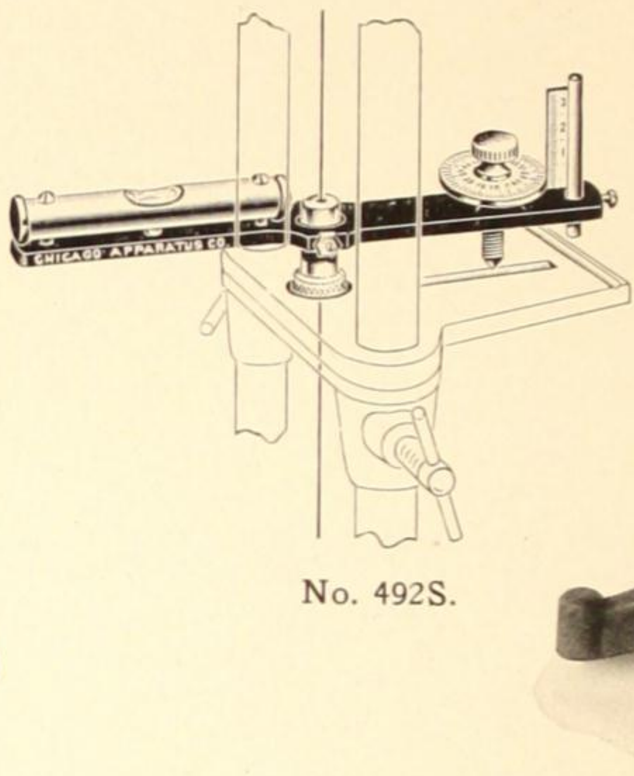


No. 486S.

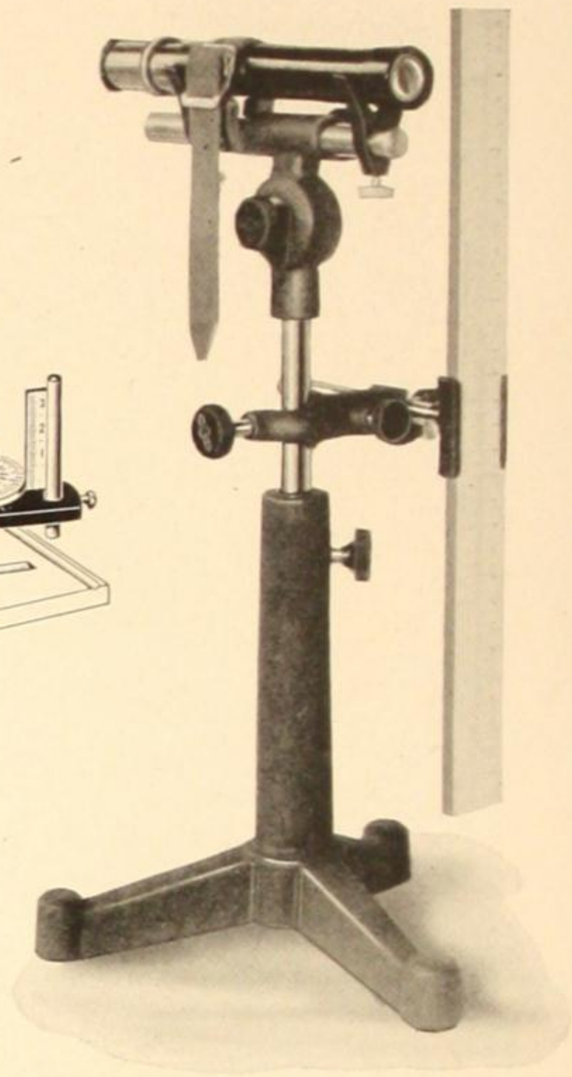


No. 490S.

No. 495S.



No. 492S.



No. 493S.

485S. Wire Testing Apparatus, Simple Form. For measuring tensile strength of wires. Consists of a fastening clamp, a tension clamp, and a guard or balance block $5.00

486S. Wire Testing Machine, Milvay Vertical Type. A demonstration as well as a students' laboratory piece. A great advantage in lecture work—every detail is visible to the whole class. This one feature alone makes it far superior to the horizontal type. There is absolutely no bang or recoil when the wire breaks. As the pull on the wire increases (by turning the crank) the pointer of the balance moves down. When the wire breaks it does not fly back. It remains exactly at the highest reading attained, making it possible to determine the breaking point very accurately. Complete with balance calibrated to 15 kilos in 100 gram divisions and 30 lbs. in ¼-lb. divisions $13.50

490S. Young's Modulus Apparatus. Consists of two heavy steel rods 100 cm. high, mounted on tripod with lug and screws. At the upper ends of the rods is a strong clamp for holding the wire. The clamp near the end of the wire is a small bushing of hardened steel on which one leg of the optical lever rests, while the other two legs rest on an adjustable platform attached to the support rods. Elongation of the wire may be measured by a telescope and scale or a micrometer microscope clamped to one of the supporting rods. Complete with optical lever and weights (10 kg.), but without telescope or microscope $30.00

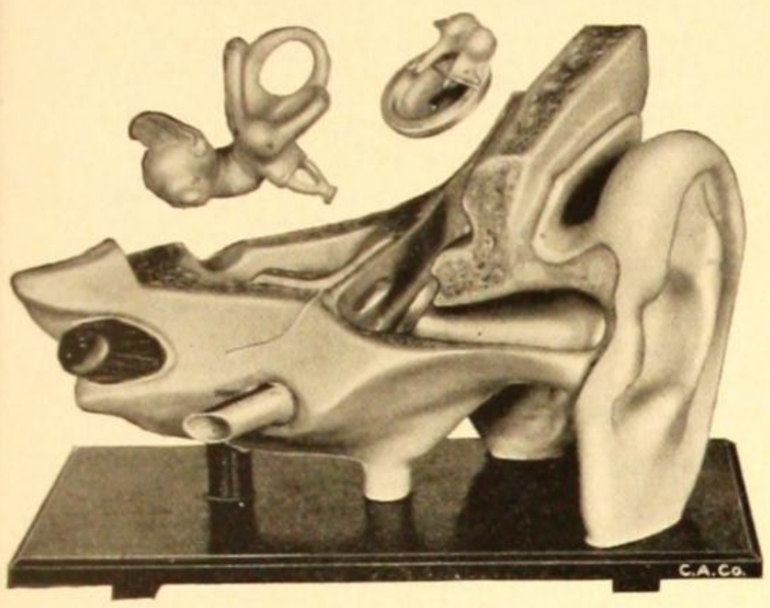
491S. Young's Modulus Apparatus. Same as No. 490S, but without optical lever $23.00

492S. Searle's Measuring Device. For use in measuring the elongation of the wire in our No. 490S Young's Modulus Apparatus. Consists of a lever with a micrometer screw at one end and a level, sensitive to 5′ at the other. At the center is a pivoted chuck for attaching the device to the wire. This chuck is of the split type, insuring a firm grip without injury to the wire. The micrometer is graduated to read direct to .01 mm. In use the device is attached to the wire so that the tip of the micrometer screw engages one of the slots in the platform, as shown in the illustration. This prevents shifting, should the wire twist under test. The micrometer screw is then adjusted until the bubble in the level is exactly between the pair of cross lines etched into the level glass. The micrometer reading is then noted. The load at the lower end of the wire is then increased and the micrometer screw readjusted until the bubble in the level returns to its former position. The difference in the two readings is the elongation for the added load. Additional readings for additional loads are obtained in the same way. Because of its simplicity, convenience, ruggedness, and dependability, this device is rapidly gaining in favor $15.00

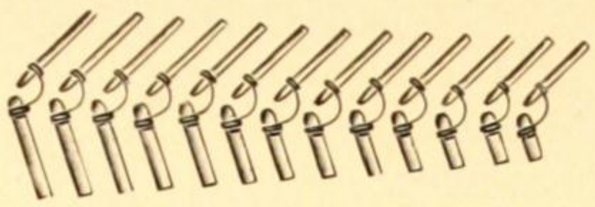
493S. Reading Telescope (Gaertner). Specially designed for Young's Modulus Apparatus and general laboratory use. The telescope is fitted with an achromatic objective 18 mm. aperture, 125 mm. focal length, focusable from infinity to 40 cm. The support is provided with all necessary adjustments and is fitted with our new style Bakelite Head brass clamping screws. The scale 50 cm. long with 0 in the center is printed on bristol board and glued on to a birch strip. It is fitted with a clamping arrangement which permits its use in both vertical or horizontal positions. Complete $25.00

495S. Torsion Pendulum Attachment. For No. 490S. Consists of brass disk about 96 mm. in diameter and about 2 cm. thick and a brass ring of the same outside diameter having approximately the same moment of inertia. The disk has a reference line on its edge for use in determining its period. The clamp for wire screws into the disk and is readily removable. Complete with wire $11.50

Apparatus for Sound



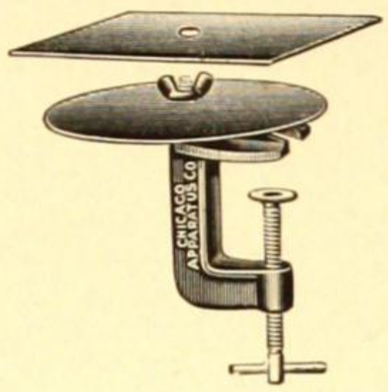
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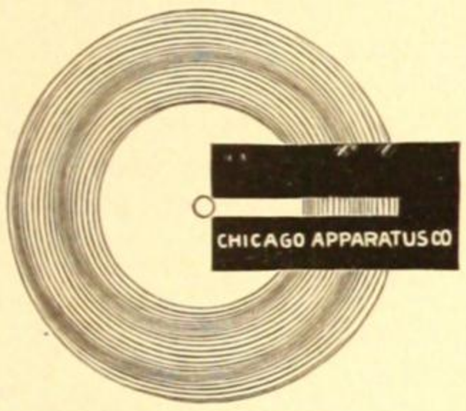
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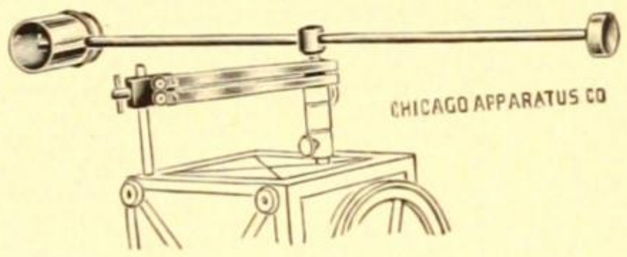
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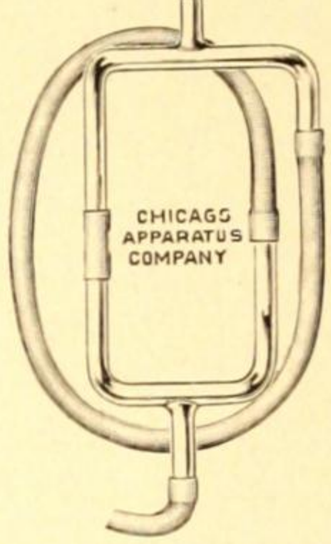
No. 505S.



No. 515S.



No. 933R.



No. 517S.

7520. **Model of Ear.** Divisible into three parts. The external ear, the middle ear of tympanum, and the internal ear or labyrinth. Dissectible into parts showing the membrana tympani, the ossicles of the tympanum, the labyrinth and the half opened cochlea **$15.00**

500S. **Acoustic Tubes, Quincke's.** A set of seven glass whistles for illustrating the effects of different diameters and lengths of tube on pitch. With two of the whistles interference may be shown **$2.50**

39R. **Bell in Vacuo.** For showing that sound is not transmitted through a vacuum. A bell jar with an electric bell suspended from springs with binding posts outside **$4.50**

40R. **Bell in Vacuo, Bottle Type.** For showing that sound waves are not transmitted by a vacuum. Consists of a small bell so mounted on the end of a flexible reed that its clapper will strike the bell when the bottle is shaken. The bottle is 4000 CC. in size and is provided with stopper and stopcock. Fits any pump plate. This design is intended to be removed from the pump after evacuation and to be passed about the class so that each student may test for himself the effect of the absence of the transmitting medium on sound..... **$3.00**

505S. **Chladni Plate Apparatus.** A round and a square metal plate 15 cm. in diameter on iron table clamp. Fine white sand or lycopodium powder sprinkled over plate will arrange itself in peculiar figures when the plate is bowed **$3.00**

510S. **Cork Dust.** Fine, for use in Kundt's Apparatus. Per 4-ounce carton **$0.20**

515S. **Crova's Disk.** For illustrating waves of condensation and rarefaction. A white cardboard disk, 30 cm. in diameter, with a series of black eccentric circles on it. When this disk is rotated and a slit held in front of it, a very realistic wave effect is seen. Complete with slit. Fits any rotator.... **$1.10**

933R. **Doppler's Principle Apparatus, Milvay Electric Design.** Consists of an electrically operated reed mounted on the end of a 60 cm. rod. When operated this reed apparently gives forth notes of different pitch—higher when it moves towards and lower when it moves away from the observer. Operates on a single dry cell. Far more convenient and yields far better results that the older models **$5.00**

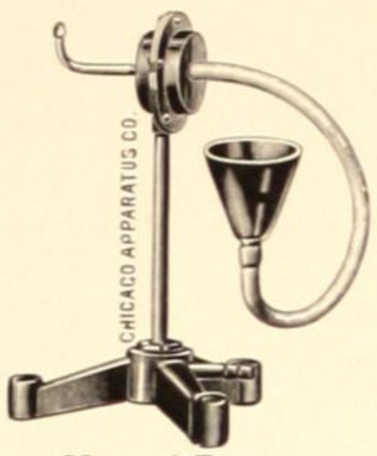
517S. **Interference Tubes.** After Quincke. Designed for use with 512 V. P. S. Tuning Fork to show the interference of sound waves traversing two separate paths of unequal lengths. Consists of two forked glass tubes connected by rubber tubing as illustrated. When a tuning fork is held before the open end and the other open end held to the ear no sound will be heard. However, when the long path is closed by pinching the long rubber tube the note of the fork is immediately heard. The difference in length of the two paths is adjusted to equal half the wave length of the note given out by the fork, causing complete interference **$1.75**



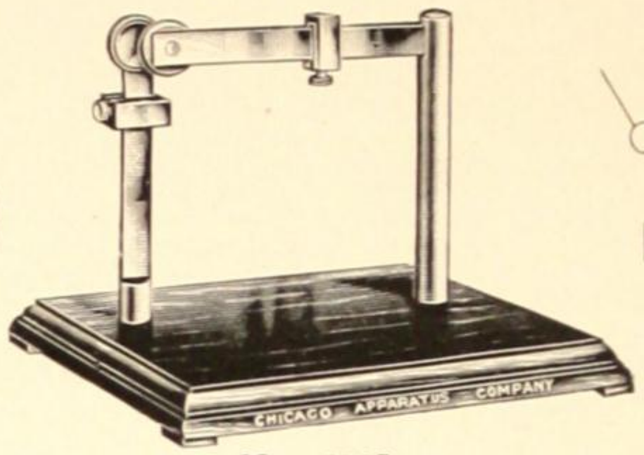
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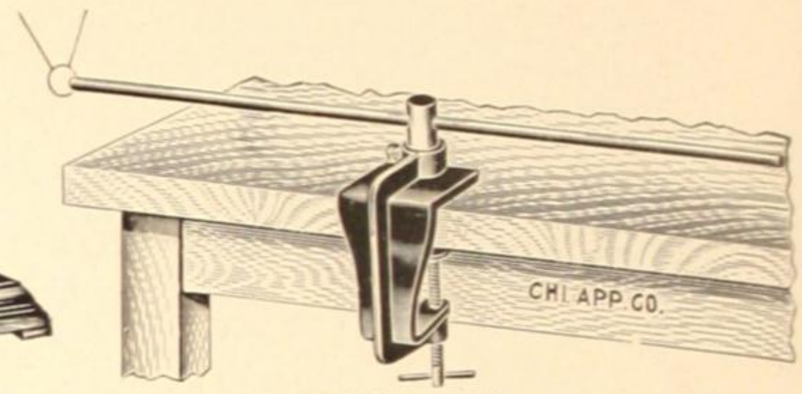
No. 520S.



No. 955R.



No. 526S.



No. 527S.

520S. Kundt's Apparatus, Milvay Improved Design with Metal Support and Attached Clamp. For determining the velocity of sound in brass and air. The six rubber pieces on the horizontal metal rods not only support the glass tube perfectly, but prevent side-shift when the piston is moved back and forth. The clamp is an integral part and provides an easy means of securely fastening the apparatus to the edge of the table. When not in use it may be turned up to lie flat on the apparatus shelf. The position of the clamp, without use of any tools, may be quickly changed to the other end or other side of the apparatus. The "Vise" construction is new. It centers the brass rod perfectly and grips it securely. The glass tube measures 120x4 cm. This new apparatus, developed by our engineers, is a distinct improvement over the old wood base type **$8.50**

522S. Kundt's Apparatus for Gases. Same as No. 520S, but with glass tube provided with two stopcocks for the introduction of different gases.. **$10.00**

525S. Lycopodium Powder. For use with Kundt's Apparatus, Chladin Plates, etc. **Per ounce package** **$0.25**

954R. Manometric Flame Mirror. Size 11x11x11 cm., strong wooden frame, best quality mirrors, 6 mm. spindle accurately centered and balanced. Fits any rotator **$5.00**

955R. Manometric Flame Vibrator. Metal gas chamber with sensitive membrane, japanned iron stand, improved flame tip, mouthpiece with flexible tube **$4.00**

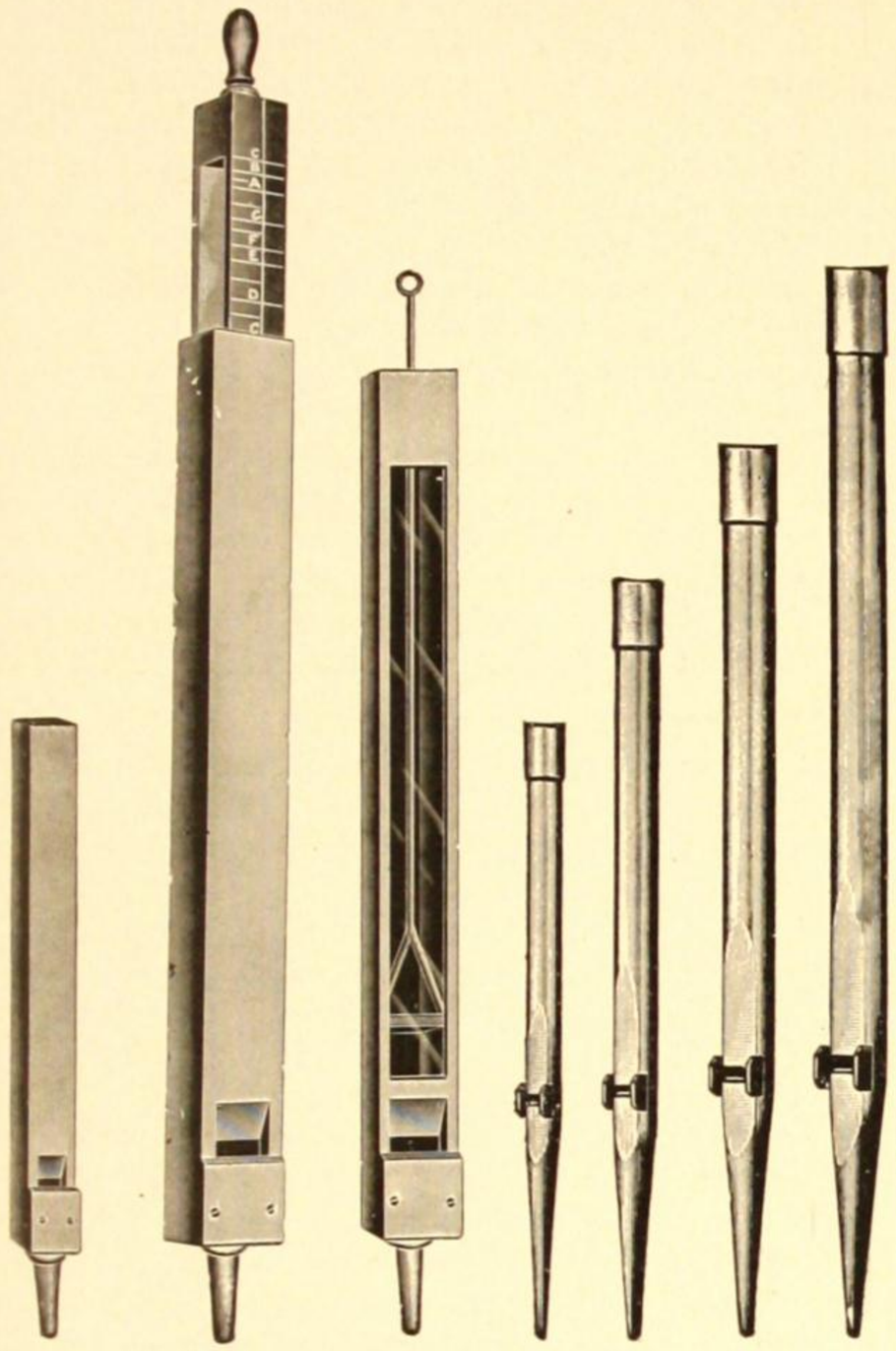
526S. Lissajou's Apparatus. A simple inexpensive device—without the usual complicated adjustments—for producing figures which are the resultant of two harmonic vibrations or motions in planes at right angles to each other. The frequency ratio of the vibrating reeds is varied by changing the position of the sliding weights. A beam of sun or arc light, about 6 mm. in diameter, is so directed that it travels by reflection from the center of one mirror to the center of the other and thence to a screen placed at a suitable distance from the apparatus. On setting the reeds into vibration the light beam traces a figure or curve on the screen, the form of which is governed by the frequency ratio of the reeds. A suitable light beam is produced by placing a diaphragm with 6 mm. aperture directly in the path of a bright light, or by reflection from a section of mirror exposed through a 6 mm. hole in a piece of paper attached to its surface. The support is extra heavy to prevent damping of the vibrations. Size of base 9x20 cm..... **$10.00**

527S. Longitudinal Vibrations Apparatus. Consists of a 100x1 cm. round brass rod held rigidly at its middle point in a table clamp. In use an ivory ball, our No. 575R, is suspended from a support so that it touches one free end of the brass rod. The other free end is then stroked with a cloth, upon which there is a little powdered rosin. A high musical note results, and at the same time the ivory ball rebounds vigorously, showing that the rod is in vibration in the direction of its length, hence the designation—longitudinal vibrations. In this case, the ends of the rod vibrate simultaneously away from and towards the center, which remains perfectly steady. For conevenience, the rod is detachable. Fits table 7 cm. thick or less. Without ivory ball..... **$3.50**

528S. Oscillograph. A small box of cardboard (about 7x10 cm.) with rubber diaphragm top to which a "speck" mirror is attached. Blowing, whistling or talking across the side opening causes the inside air to vibrate. The rubber diaphragm follows these vibrations perfectly and they may be made visible and greatly magnified by reflecting a beam of light from the "speck" mirror to a wall or screen. Different tones will produce different Lissajou's figures on the screen **$0.50**



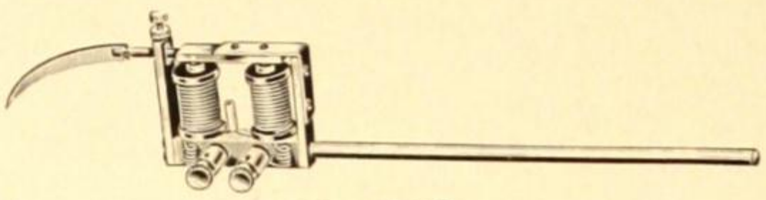
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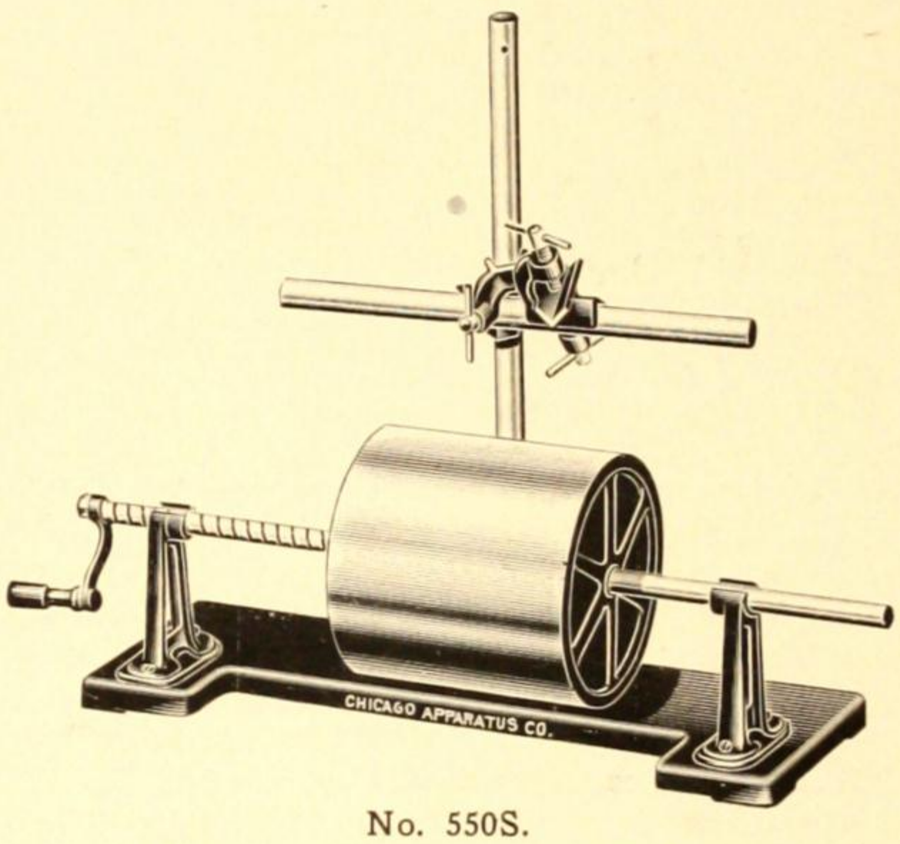
No. 530S. No. 535S. No. 540S. No. 542S.



No. 545S.



No. 552S.



No. 550S.

530S. Organ Pipe. Wood, plain, size, about 55x4.5x4.5 cm. **$2.25**

535S. Organ Pipe. Wood, sounding two octaves, with tones and semi-tones marked on the sliding piston. Size, about 90x7.5x8 cm. **$6.00**

540S. Organ Pipe. Wood, one side of glass, with membrane on sliding frame. Pith balls or cork dust placed on the membrane will indicate position of nodes and loops in the vibrating air columns. Size, about 80x6.5x6.5 cm. **$7.00**

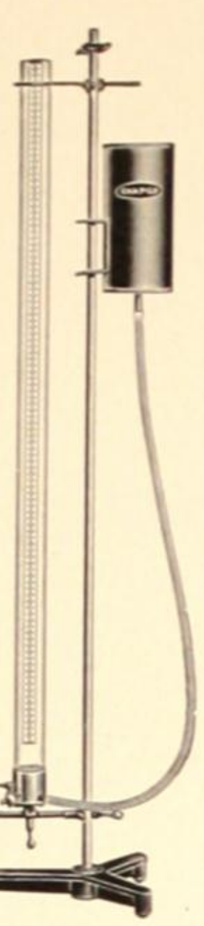
542S. Organ Pipes, Metal. Set of four organ pipes, giving the chords C', E', G', and C''. Same substantial construction as used in pipe organs and provided with sliding tubes for tuning..... **$15.00**

545S. Pitch Pipe. Chromatic, metal, with indicator and slide for sounding any note in the octave... **$1.00**

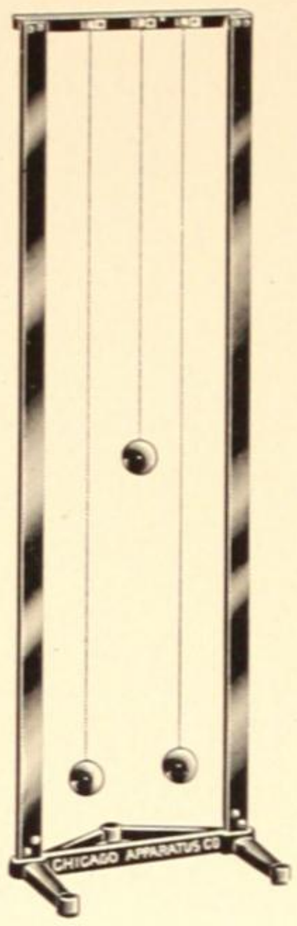
550S. Recording Drum. For determining the frequency of tuning forks by the graphic method. A sheet of coated paper (No.551S) is wrapped around the cylinder. The fork is mounted so that its style touches the paper lightly. When the cylinder is turned it also moves—one centimeter for each revolution—along its axis. The beats of a seconds pendulum may be marked on the paper by placing it in circuit with a time marker (No. 552S) mounted alongside of the fork. The number of fork waves between successive time-marker marks is equal to the v.p.s of the fork. This method gives extremely accurate results. The drum is 15 cm. in diameter and 15 cm. long. Its surface is turned true. The lateral motion of the drum is in excess of 15 cm. so that the entire surface may be covered with tracings. The support is finely finished in black glass enamel. The two massive support rods are heavily nickel-plated. Clamps for supporting the cross-rod and tuning fork are included. Complete as illustrated, but without tuning fork..... **$32.50**

551S. Coated Paper. For use with No. 550S Recording Drum. Size 15x50 cm. A special blue paper coated with a fine film of white wax. The lightest touch of a style removes the wax, leaving a legible blue trace on a white background. These tracings make permanent records for the student's note book. **Per package of 25 sheets** **$0.25**

552S. Time Marker, Electric. For use in circuit with a clock or seconds pendulum for marking off exact one-second time intervals on No. 550S Recording Drum. Mounted on 6 mm. rod 15 cm. long, for clamping to a support. Provided with celluloid stylus. Positive in action and very compact. Operates on one dry cell **$7.00**



No. 565S.



No. 567S.

560S. Resonance Apparatus. Glass cylinder, 37.5 by 7.5 cm., glass tube, 45x5 cm., and iron support with clamp. In use, the cylinder is nearly filled with water and the glass tube clamped so its lower end is immersed. By moving the tube up and down the point of resonance is easily located.....**$4.50**

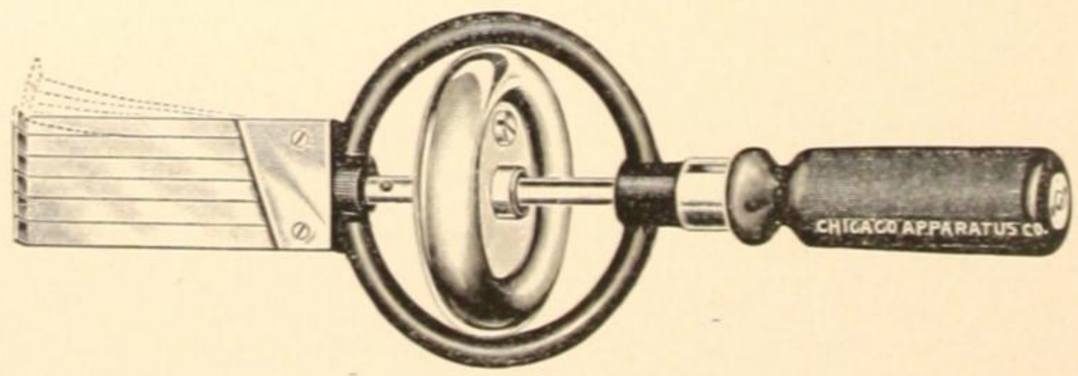
565S. Resonance Apparatus. Improved design. A large diameter glass tube more than one meter long, provided with a millimeter scale, is sealed into a brass cup at the bottom and mounted on a suitable support. A supply tank is attached to the rod of this support by means of a clamp which permits of very rapid adjustment. The outlet in the bottom of the supply tank is connected with the inlet in the brass cup at the bottom of the tube. A clamp for holding a tuning fork directly over the mouth of the tube is provided. As the tube is adjustably mounted, any size fork up to 10 inches may be used. Price complete, but without tuning fork **$15.00**

567S. Resonance Pendulums, Milvay, with Non-Wobbling Three-Point Base. The wobbling of the four-point base prevents resonance pendulums from working properly. Our three-point base is absolutely non-wobbling and therefore always gives perfect results. The bobs are 5 cm. iron balls adjustably attached to a cross-bar fixed to the top of two flexible steel strips, 100 cm. long. When the outer pendulums are adjusted to the same length and one set in motion the second begins to swing with gradually increasing amplitude while the amplitude of the first decreases correspondingly. When the second pendulum reaches its maximum amplitude the first comes entirely to rest, then the process reverses itself and the first pendulum absorbs the energy of the second. The short pendulum shows the lack of resonance between two pendulums of different lengths **$12.50**

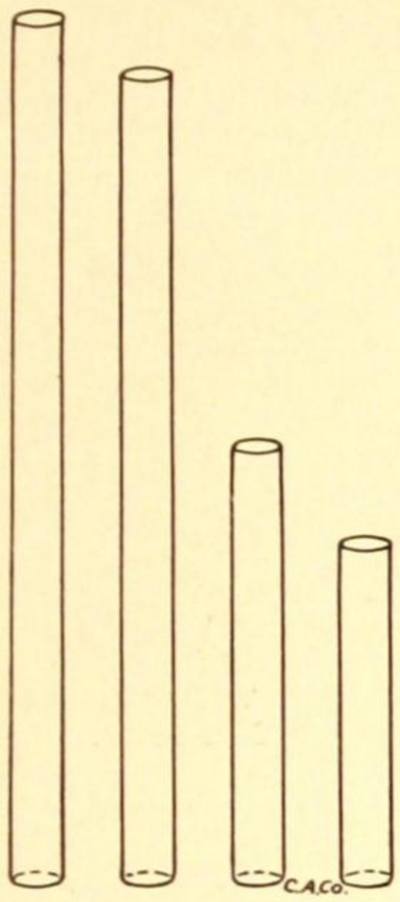
568S. Frahm's Resonance Top. The action of this top provides a most striking demonstration of resonance or sympathetic vibration—the principle upon which the Frahm vibrating reed tachometer operates. (See Glaser's Ann., vol. 59, 1906, page 697.) Likewise it also illustrates the effect of unbalanced rotating parts on the vibration of machinery.

Consists of a gyroscopic wheel with heavy rim mounted between steel cone bearing in a brass frame with handle attached. Fixed to the frame is a so-called Frahm comb with six vibrating metallic reeds varying in length and natural period of vibration. The free ends of the reeds are bent at right angles and painted red to increase the visibility.

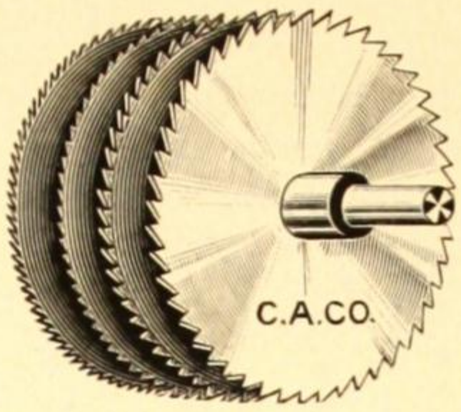
The wheel is unbalanced by being loaded at one point near the circumference. Consequently, when rotating it produces vibrations in the frame at a rate equal to the speed of rotation. These vibrations are in turn transferred by the frame to the reeds. While the wheel is rotating at a speed above or below the natural frequency of the reeds they will not vibrate. However, when the speed coincides with the natural frequency of any reed it will vibrate vigorously through an arc about 2.5 cm. long. With a cord the wheel is easily caused to rotate at a speed in excess of the highest reed frequency. As the speed diminishes one reed after another will take up the vibration—a most fascinating demonstration of vibratory action and resonance.....**$18.00**



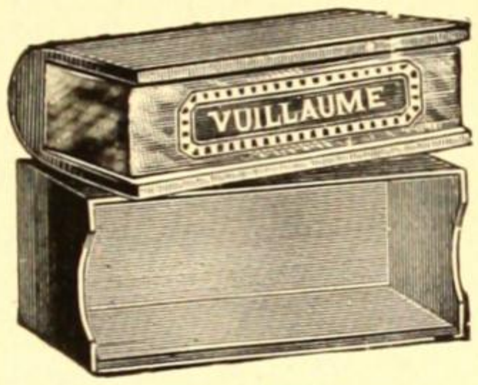
No. 568S.



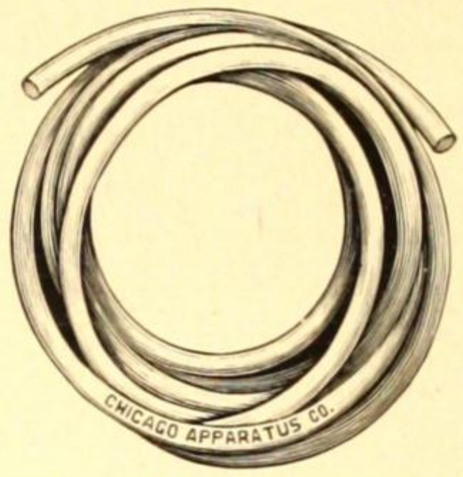
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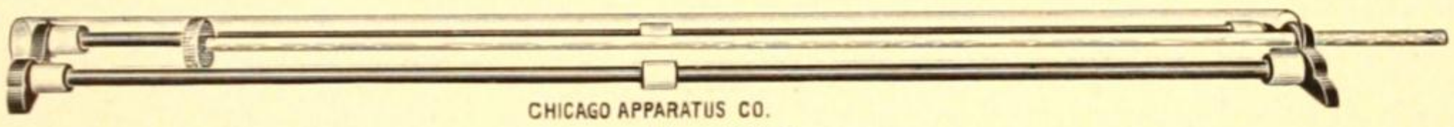
No. 605S.



No. 585S.



No. 590S.



No. 570S.

1187C. Resonance Tubes, Glass, with annealed ends.

No.	7	8	9	11
Diameter, outside, cm.	3	4	4	4
Length, cm.	120	45	60	110
Each	**$1.35**	**1.00**	**1.25**	**2.00**

570S. Resonance Tube, Milvay Improved Design with Metal Support. The six rubber pieces on the horizontal metal rods support the glass tube perfectly and prevent side-shift when the piston is moved. Complete with glass tube, 120x4 cm.; and piston for varying the length of the vibrating air column. An opening in the right-hand end casting forms a perfect guide for the piston handle. More compact and therefore easier to store and handle than the old wood base type..... **$4.00**

572S. Resonance Tube Attachment. Millikan and Gale's Exp. No. 41. For use with No. 489R Glass Tube **$0.75**

575S. Revolver. As used in Millikan, Gale and Bishop's Course in experiment on the speed of sound in air. Five shot, 22 caliber..... **$7.50**

580S. Rods. For longitudinal vibrations. Set of three steel, pine, hardwood—each 100 cm. long and 10 mm. in diameter. **Per set**..... **$0.60**

585S. Rosin. Fine quality. For use on violin bows and rods. **Per cake** **$0.15**

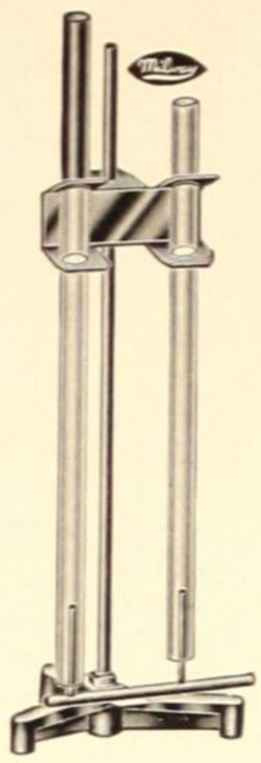
590S. Rubber Cord. For showing progressive wave motion. Three meters long **$0.75**

595S. Sand, White. Best quality, carefully sifted. For use with Chladni Plates, Kundt's Apparatus, etc. **Per pound package** **$0.20**

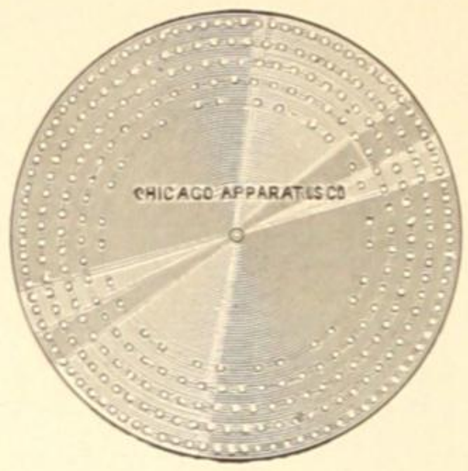
605S. Savart's Toothed Wheels. Four metal wheels, 75 mm. in diameter, each having a different number of teeth. Will sound a major chord when rotated rapidly and card held against the teeth. Mounted on a common axle. Fits either No. 900R or No. 896R rotator **$2.75**



No. 607S.



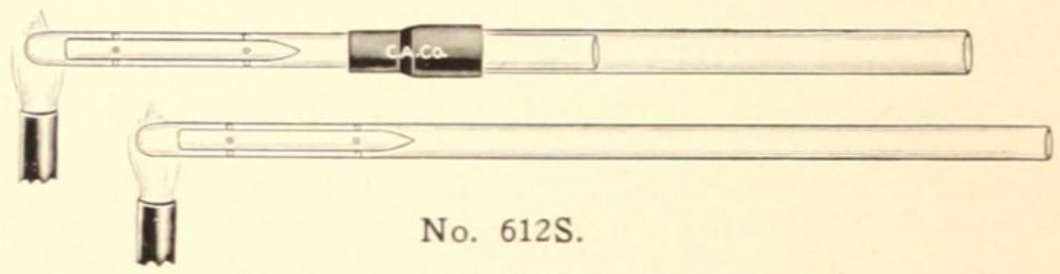
No. 610S.



No. 969R.



No. 974R.



No. 612S.

607S. Sensitive Flame Burner. Produces a long narrow flame (when gas is lighted above gauze) that is just on the point of flaring. Any sharp sound—a shrill whistle, rattle of keys, or note of a high frequency tuning fork—will cause the flame to drop to about half its normal height and to flare in that form as long as the sound continues. Because of its great sensitivity to high pitches this form of flame is useful in detecting sounds above the limit of hearing. Consists of a special pointed gas burner over which a gauze circle adjustable for height is supported **$3.00**

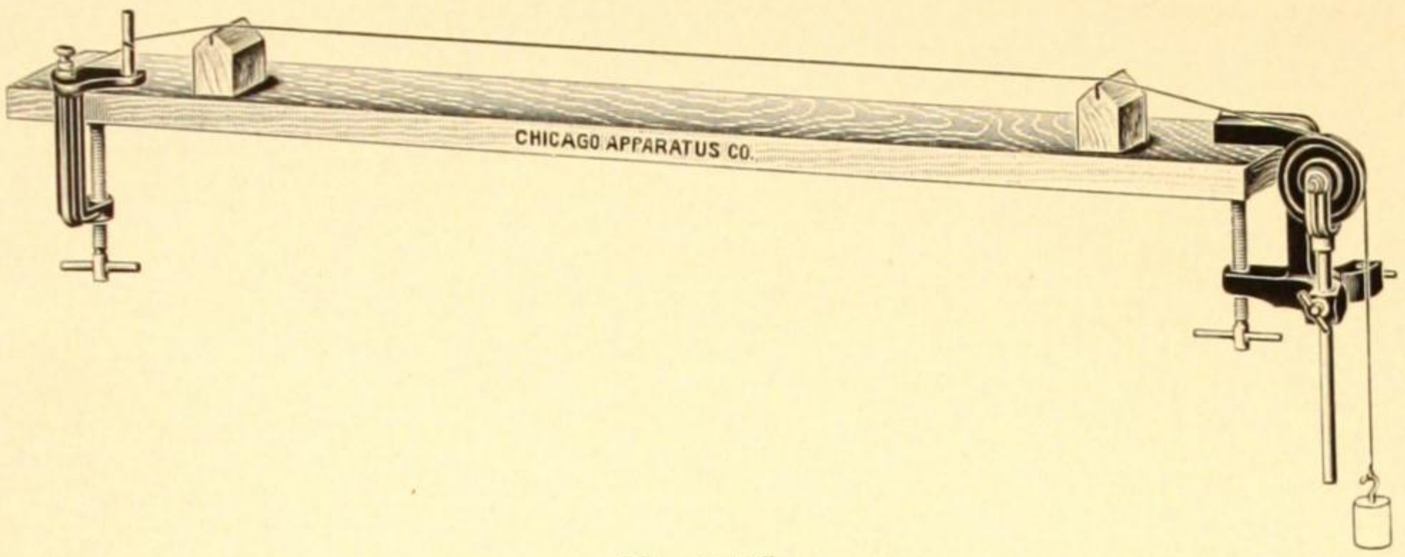
610S. Singing Flame Apparatus. Milvay. Two glass resonant tubes about 45 cm. long, mounted on a support over two gas jets. The length of one tube may be increased by means of the sliding metal tube with which it is provided. This changes its fundamental tone and thus gives rise to the phenomena of beats and discords **$8.00**

612S. Singing Tubes. An ingenious source of sound. Consists of a small closed tube mounted within a larger closed tube as illustrated. When the closed end of the outer tube is gently heated in a flame a sustained powerful, piercing tone is emitted. One tube has an auxilliary sliding tube with snug fitting rubber sleeve for varying its effective length, and hence the pitch of the emitted tone. The two tubes, when used together, are convenient for producing sustained beats. Reference—Page 557, "Physics," by Duff, Lewis, Mendenhall, Carman and Knipp. (1926). **Per set** **$6.00**

969R. Siren Disk. Metal, 22.5 cm. in diameter. Has five rows of holes, four evenly spaced, giving the chord do-me-sol-do; the other, unevenly spaced, a noise, 6 mm. center hole. Fits either No. 900R or No. 896R Rotator **$1.25**

974R. Siren Disk and Color Disk. Milvay Improved. Metal, 24 cm. in diameter. Has five rows of holes, four evenly spaced and one unevenly spaced; toothed edge and primary colors in proper proportion in center. These colors are processed directly on the metal which permits washing of the disk when it becomes dirty, likewise there is no peeling of a colored paper surface rendering the disk useless, such as occurs in ordinary forms. Three disks in one—Siren Disk, Savart's Wheel, and Newton's, 6 mm. center hole. Fits any Rotator **$2.00**

Sonometers



No. 613S.



No. 615S.

613S. Sonometer, Simple Form. Consists of a No. 870R Pulley with Clamp, two No. 362S Prisms with Brass Edge, a No. 330D Spool of Piano Wire No. 6, and a special Fastening Clamp. For weights to be used with this apparatus see No. 352B Universal Hook Weights. Without weights **$3.75**

615S. Sonometer. For illustrating the laws of vibrating strings. A resonant case with millimeter scale one meter long. On this scale are also indicated the lengths of string necessary to give the notes in the Diatonic and Equally Tempered Scale between C'—256 V. P. S. and C" "—1024 V. P. S. Provided with two fine adjustment tension keys, two bridges so shaped that the exact string position of the bridge may be noted on the scale, and one No. 645S set of wires **$8.75**

620S. Sonometer. Same as No. 615S, but with three tension keys and three bridges..... **$10.00**

630S. Sonometer. Same as No. 615S, but fitted with two pulleys so that tension may be secured by suspending weights from the free ends of the wires. Price does not include weights and weight hangers; they are listed separately on the following page under Nos. 331B and 336B..... **$13.50**

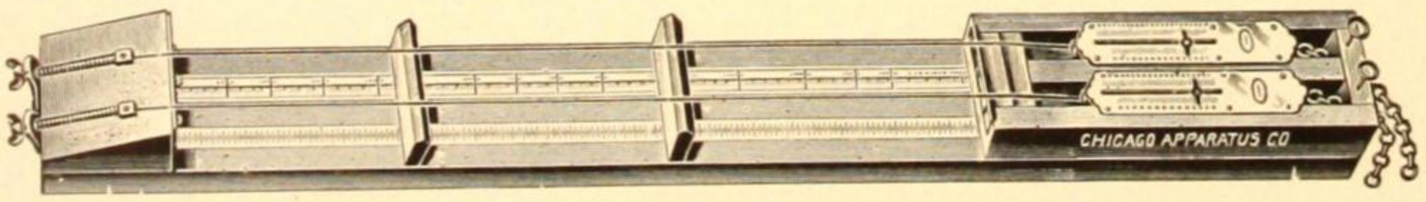
631S. Extra Bridges, to fit No. 615S, 620S, or 630S Sonometers. For replacement. **Each**..... **$0.25**

632S. Sonometer, Spring Balance Tension Type with Three Strings. Sounding box of well-seasoned wood with three wires, three spring balances, and three metal-edge bridges. The tension screws are of the fine adjustment musical instrument type. The spring balances have a range of twenty-five pounds in one-half pound divisions. The millimeter scale is one meter long and on it are indicated the lengths of wire necessary to give the notes in the Diatonic, and Equally Tempered Scales. Complete with No. 645S Set of Four Sonometer Wires..... **$17.50**

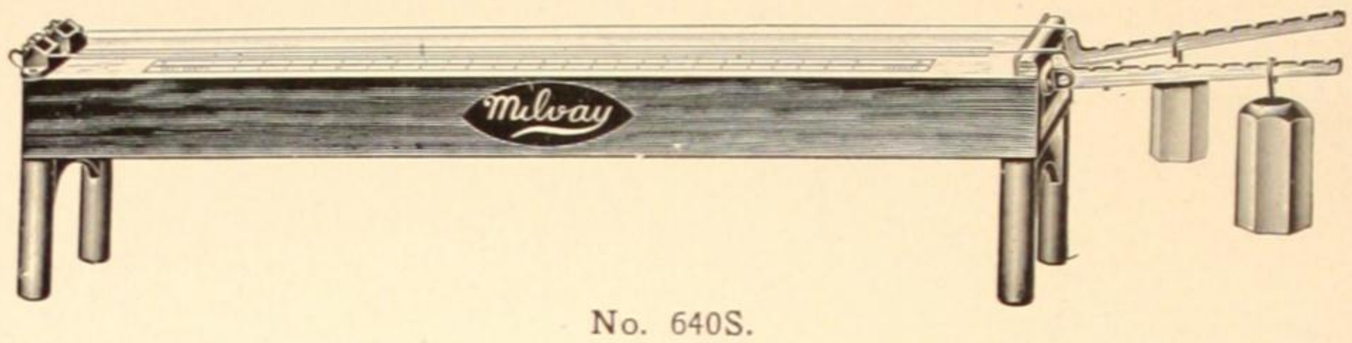
635S. Sonometer. Made of heavy well-seasoned hardwood. The tension is measured by two large Ffteen Kilogram Balances. Tension adjustment is secured by two quick-acting screws which replace the old-style tension keys. The scale is the same as in No. 615S. Complete with one No. 645S Set of Four Wires and two special bridges..... **$19.50**



No. 632S.



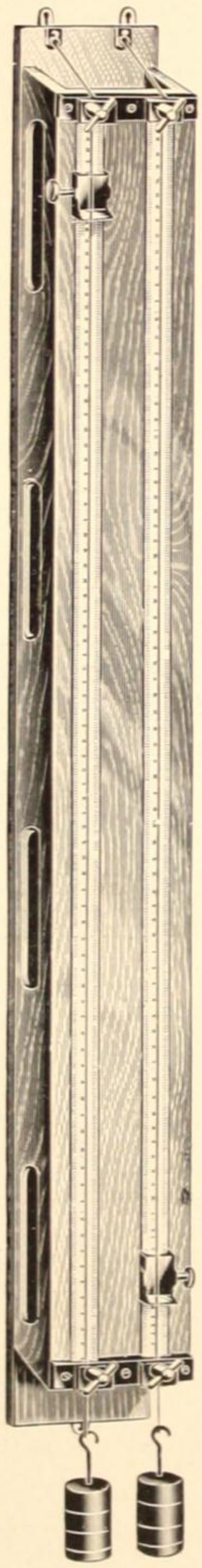
No. 635S.



No. 640S.



Nos. 331B-336B.



No. 642S.

640S. Sonometer, Lever Tension Type, Milvay. In this new sonometer the tension is produced by weights suspended from multiplying levers. Each lever has ten notches. It is therefore possible to secure tensions of from 1 to 10 kilos and 3 to 30 kilos by merely sliding the special 1 and 3 kilo weights furnished along these levers.

The resonant case is made from specially selected kiln-dried wood and is mounted on legs. It is provided with a millimeter scale 1 meter long, on which are also indicated lengths of string necessary to give the notes in the Diatonic and Equally Tempered Scale. Two fine adjustment tension keys are mounted on the end opposite the lever.

Furnished complete, with two bridges shaped so that they show the exact string positions on the scale, a set of four sonometer wires, No. 645S, and a special 1 kilo and 3 kilo weight **$16.00**

642S. Sonometer, Two-Meter, Vertical Wall Form. Ideal for lecture and laboratory use. Scales are of wood, two meters long and graduated in millimeters. Each is provided with a sliding metal bridge which can be locked in position at any point along the scales. This construction permits greater accuracy in the measurement of effective length. Both wires can be locked at the bottom to prevent change after tension adjustment.

Tension is applied directly—without friction—by the slotted weight and hanger method. The sounding board is of clear spruce in natural finish, mounted on a mahogany-finish base 2.25 meters (79 inches) long. Four rubber cushions are attached to the back to prevent deadening of the sound by the wall. For mounting, two metal wall brackets are provided.

The two-meter range is more suitable for testing the laws of vibrating strings. Also, the student can see every detail of manipulation better in the large wall type, and hence gain a better understanding of the laws of vibrating strings. Further, once installed, it takes up practically no room, and is always ready for use.

Complete, as illustrated, with two steel wires, .014 and .028 inch diameter, but without hangers or weights **$45.00**

331B. Sonometer Weights, Metric, Slotted. For securing tension by the suspended weight method in sonometers like our Nos. 630S and 642S. Diameter, 95 mm. Designed to be used in connection with No. 336B Weight Holder. Made of iron, finished in black japan.

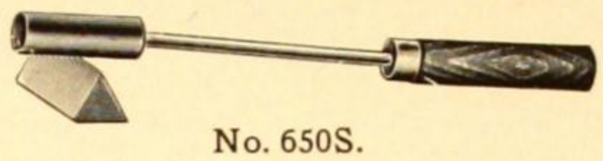
Size, kilos	½	1	2	5
Each	**$0.50**	**.65**	**1.00**	**2.30**

336B. Weight Hanger. For holding No. 331B Slotted Weights. Adjusted to weigh 1 kilo. Will hold weights totaling up to 20 kilos. Diameter of end plate, 95 mm.; length of rod, 55 cm. Made of iron, finished in black japan..... **$1.15**

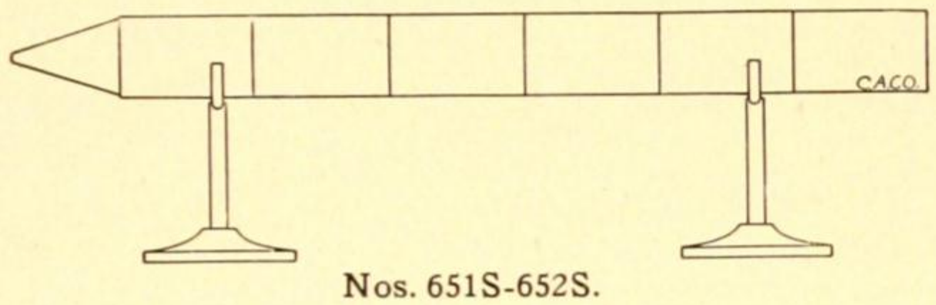
645S. Sonometer Wires. Four wires, 120 cm. long, with loops; two of steel .014 inch in diameter, one each of steel and brass .028 inch in diameter..... **Per set $0.50**



No. 331H.



No. 650S.



Nos. 651S-652S.

331H. Sound and Heat Reflectors. This apparatus will demonstrate in a most striking and forceful manner the fact that sound waves (and heat waves) can be reflected and brought to a focus the same as light waves. It illustrates and explains the secret of whispering galleries and the principle of sound reflectors used in large halls and auditoriums. Repeated tests in our own laboratories show that our apparatus will work as perfectly over distances of 30 feet as it will when separated only a few feet. As shown in the illustration a Galton Whistle is placed in the focus of one reflector and a sensitive flame in the other. When whistle and burner are at the focal points of the reflectors and the whistle is caused to emit a note, the flaring of the sensitive flame instantly indicates the reflection of the sound waves. When whistle and burner are not at the focal points the flame will not flare, thus showing that the sound waves are not reflected as before. The two parabolic reflectors are 30 cm. in diameter, accurately spun, nickeled, and highly polished. They are adjustably mounted on tripod supports. One is provided with a support for Galton's Whistle and the other with a sensitive flame burner, both adjustable. Complete with sensitive flame burner (also ball and phosphorus holder for demonstrating heat reflection), but without Galton's Whistle. (For Galton's Whistle, see No. 778S.) **$24.00**

650S. Trevelyan's Rocker. A lead prism and a grooved brass rocker with rod and counterbalance. (The counterbalance—a metal ball—replaces handle shown in illustration.) When the rocker is placed on the lead prism it will vibrate rapidly and produce a musical sound **$3.25**

651S. Tube with Cone. For illustrating wave motion in air. Tube is 3 meters long and sectioned for convenience in storing. One end is capped with a cone having an opening of about an inch. In use, a thin sheet of rubber is stretched and tied over the large end and a lighted candle placed so the flame comes opposite the end of the cone. When two wooden blocks are struck sharply together near the rubber-covered end, the flame flares away from the end of the tube. The same thing occurs when the diaphragm is tapped lightly with the finger. Since there is no passage of air through the tube, for the end is closed, the flare of the flame must be due to the air wave sent out by the diaphragm. Without supports or rubber diaphragm.....**$3.50**

652S. Supports for No. 651S **1.50**

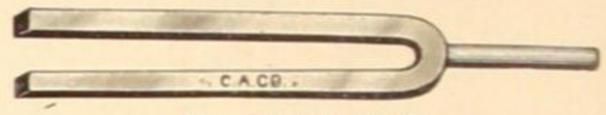
Tuning Forks



Nos. 655S-660S.



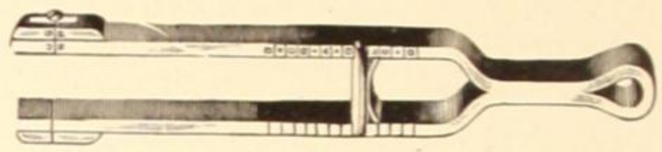
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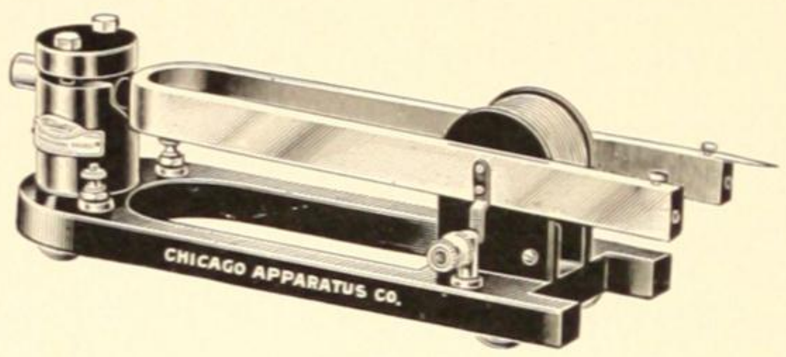
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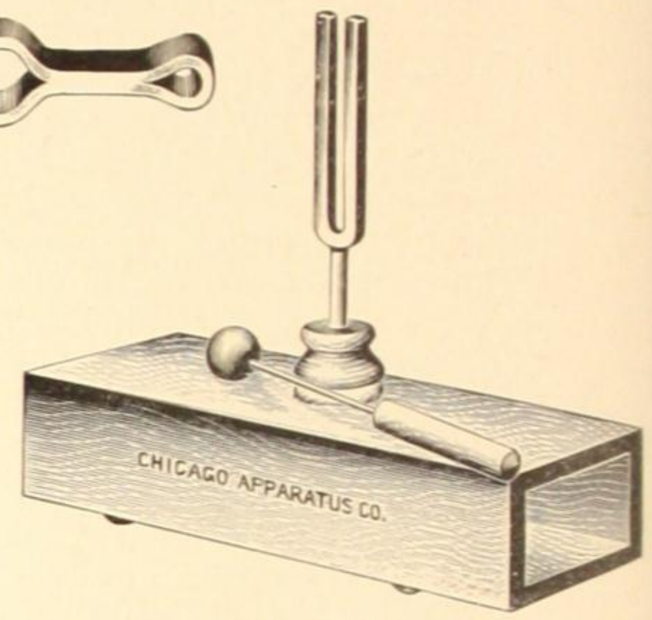
No. 695S.



No. 700S.



No. 705S.



No. 710S.

655S. Tuning Fork. A-426⅔ V. P. S., length about 12.5 cm. $0.45

660S. Tuning Fork. C-512 V. P. S., length about 12.5 cm. $0.45

665S. Tuning Fork. A-426⅔ V. P. S.; with ball handle; length about 11.5 cm. $0.75

670S. Tuning Fork. C-512 V. P. S.; with ball handle; length about 11.5 cm. $0.75

Tuning Forks. Physical pitch. Polished steel, nickel-plated, accurately tuned.

Cat. No.	Scale Letter	V. P. S.	Length, Inches	Each
674S.		100	11	$3.00
675S.	C	128	10	2.25
676S.	C'	256	7¼	1.25
677S.	D'	288	7	1.25
678S.	E'	320	6⅞	1.25
679S.	F'	341⅓	6¾	1.25
680S.	G'	384	6½	1.25
681S.	A'	426⅔	6¼	1.25
682S.	B'	480	6	1.25
683S.	C"	512	5⅞	1.25

685S. Tuning Forks. Set of four, one each C', E', G', C" (Nos. 676S, 678S, 680S and 683S), giving major chord $5.00

690S. Tuning Forks. Set of eight, one each C' to C" (Nos. 676S to 683S), giving full octave..... $10.00

695S. Tuning Fork. For use with vibrographs. Nickel-plated steel, low pitch, large amplitude of vibration; length about 21 cm., with stylus..... $1.25

700S. Tuning Fork, Adjustable. May be adjusted to sound any note from D' to D" in either international or concert pitch $2.25

705S. Tuning Fork, Electrically Maintained, Milvay, Iron Base Design. A decided improvement over the old wood base model. The heavy blows delivered by a large vibrating fork makes it impossible to clamp it to a wooden base so that it will hold securely. A loose support destroys the power of the fork—often it throws the contact points so completely out of alignment that the fork cannot function at all. These disadvantages are entirely overcome in our new model, in which the base and fork support are made of one piece of heavy cast iron. Endurance tests in our own laboratory have demonstrated conclusively that this mount will not loosen, that the fork will not lose its power, and that the contact points will not get out of alignment. The fork is extra large, the prongs measuring ½x1x12 inches, and both are fitted with small thumb-screws for attaching strings and styluses. In the end of each prong is a small hole tapped to receive mirrors No. 706S. The fork is entirely nickel-plated and its rate is about 75 V. P. S. One or two dry cells will operate it. For Melde's method of studying waves and stretched strings, for projecting Lissajou's curves, and for other work in sound vibration the present design will yield the utmost satisfaction $17.50

706S. Tuning Fork Mirrors. Two plane mirrors, 13 mm., mounted to fit the prongs of No. 705S Fork, for Lissajou's experiments $3.00

Mounted Tuning Forks

Tuning Forks, Mounted. Nos. 676S, 678S, 680S and 683S Forks mounted on resonant cases; each provided with rubber hammer.

Cat. No.	Scale Letter	V. P. S.	Each
710S.	C'	256	$5.00
712S.	E'	320	5.00
714S.	G'	384	5.00
716S.	C"	512	5.00

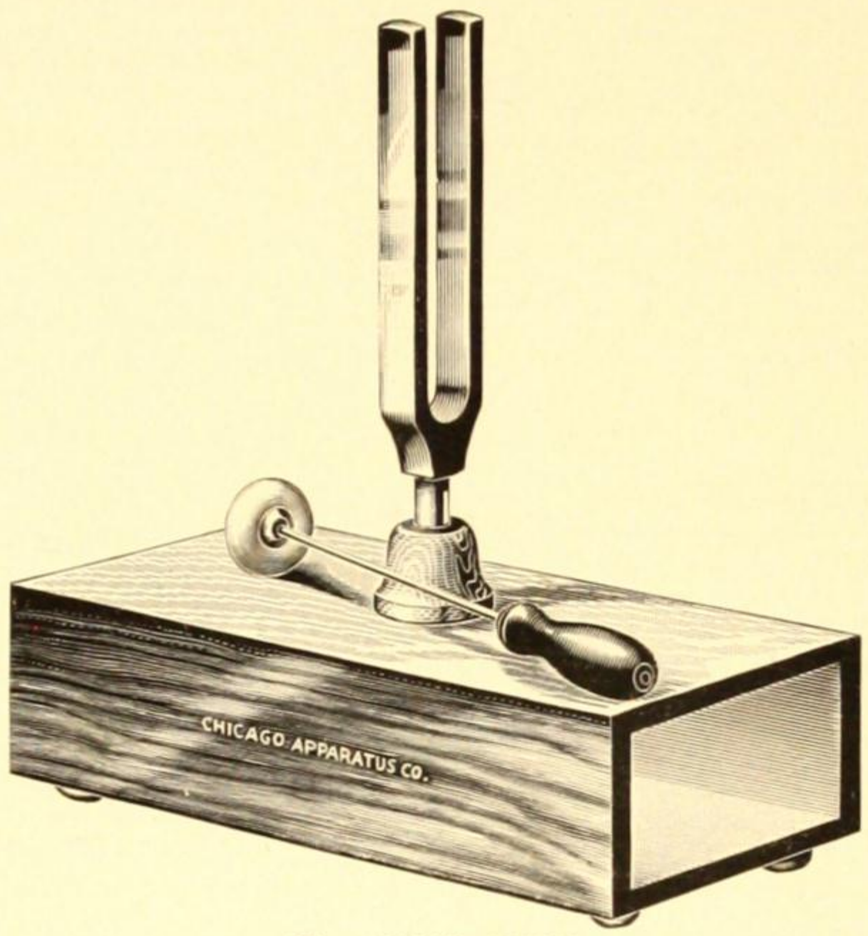
720S. Tuning Forks, Mounted. Set of forks, one each Nos. 710S, 712S, 714S and 716S, giving major chord $20.00

Tuning Forks—Extra Large and Massive

(Physical Pitch)



Nos. 4800S-4840S.



Nos. 4900S-4915S.

Do not confuse these forks with the small size, lightweight forks selling around $1.50 each. These forks are three times heavier and 10% longer. The actual weight of a C256 fork in the $1.25 grade is only 3 ounces, whereas the actual weight of the same fork in this series is 9 ounces. The prongs measure ½ inch wide by ¼ inch thick. These forks are of the highest grade, one-piece construction, made from selected steel, nickel-plated and polished, highly tempered, accurately adjusted and balanced. Amplitude of vibration, duration, and tone volume is a maximum. Repeated tests show that the C256 fork will sustain an audible tone for 30 to 40 seconds. The stems are round, slightly tapered and measure approximately ⅜ inch in diameter. The frequency adjustment is accurate to within one vibration. We can highly recommend these forks to physicists desiring better tone volume, longer sustaining power and greater accuracy —characteristics impossible in lower priced forks.

Cat. No.	Scale Letter	V. P. S.	Length, Inches	Each
4800S.	C	128	11	**$6.50**
4805S.	C'	256	8	**4.00**
4810S.	D'	288	7¾	**4.00**
4815S.	E'	320	7⅝	**4.00**
4820S.	F'	341⅓	7½	**4.00**
4825S.	G'	384	7¼	**3.75**
4830S.	A'	426⅔	7	**3.75**
4835S.	B'	480	6¾	**3.75**
4840S.	C"	512	6⅝	**3.75**

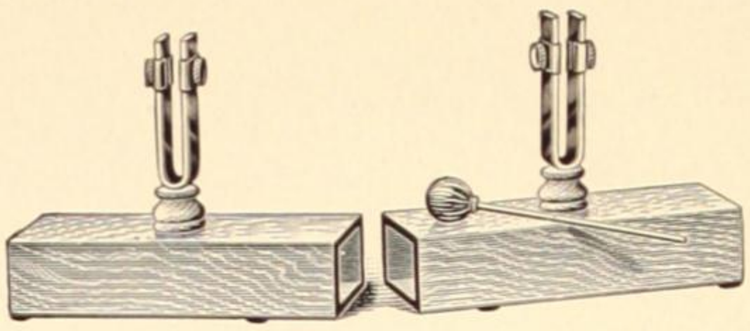
Tuning Forks, Unmounted. Extra heavy forks adjusted to physical pitch. Nos. 4845S and 4850S are adjusted to their proper frequency by weights fixed to each prong.

Cat. No.	Scale Letter	V. P. S.	Each
4845S.	C^2	32	**$15.00**
4850S.	C^1	64	**12.50**
4855S.	C^3	1024	**7.00**
4860S.	C^4	2048	**7.00**
4865S.	C^5	4096	**6.00**

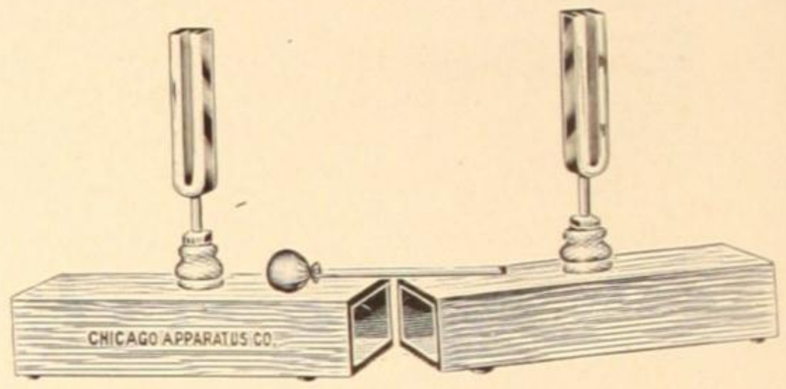
Tuning Forks—Extra Large and Massive—Mounted

Tuning Forks from series 4800S-4840S mounted on resonant cases for demonstration purposes. The five forks listed below give the chord C, C', E', G,' C". Each is provided with a rubber hammer.

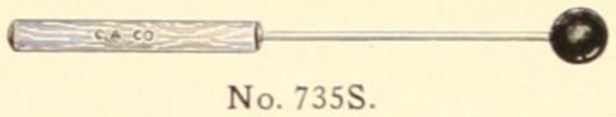
Cat. No.	Scale Letter	V. P. S.	Each
4895S.	C	128	**$13.50**
4900S.	C'	256	**7.50**
4905S.	E'	320	**7.50**
4910S.	G'	384	**7.50**
4915S.	C"	512	**7.50**



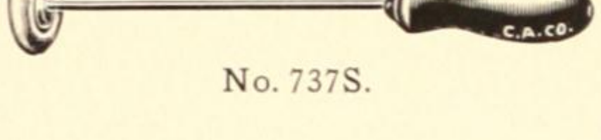
No. 725S.



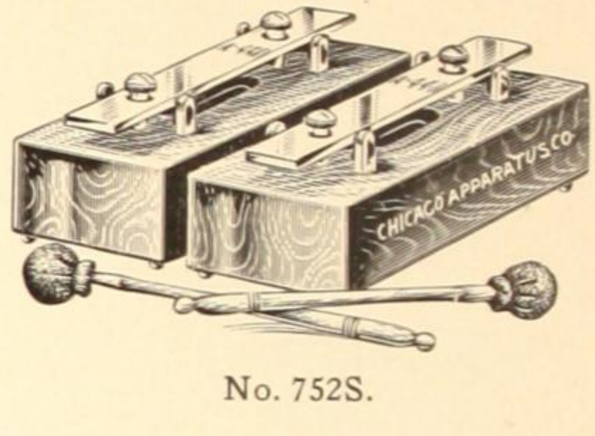
No. 730S.



No. 735S.



No. 737S.



No. 752S.

725S. Tuning Forks, Mounted Differential. A pair of heavy forks, giving normally 256 V. P. S. mounted on resonant cases. When the sliding weights are adjusted to the normal marks the forks are in unison, and therefore powerful sympathetic forks. Either fork will resound to the vibration set up in the other. By adjusting the sliding weights either above or below the normal mark their rates may be made slightly different and when sounded together will show the phenomenon of beats. The sliding weights, being provided with ball clamps, are very easy to adjust **$20.00**

730S. Tuning Forks, Mounted Sympathetic. Two extra large polished steel forks—C' 256 V. P. S.—mounted on resonant cases and tuned in perfect unison so either will respond to the vibrations set up in the other. Complete, with large rubber hammer **$15.00**

735S. Tuning Fork Hammer. Flexible metal rod type with wooden handle and rubber head about 25 mm. in diameter. Total length about 24 cm. Head is of a hardness to properly sound the various tuning forks listed in this catalogue..... **$0.25**

737S. Tuning Fork Hammer, Ring Type. Designed to deliver a quick powerful blow that will develop the maximum sound volume in tuning forks, steel bars, etc. Far superior to the ordinary rubber ball type. Rubber ring with heavy brass center on flexible steel rod with black enameled wood handle. overall length, 20 cm. **$0.75**

745S. Tuning Fork Stylus. Bristle, with wax for attaching **$0.15**

750S. Tuning Fork Styluses. Steel, with special wax for attaching. Six to set. **Per set** **$0.20**

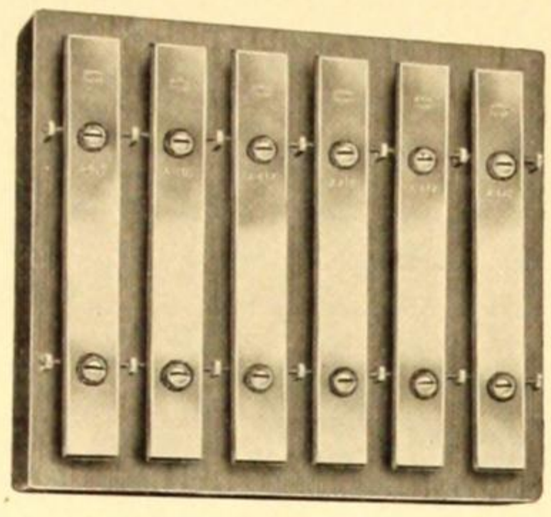
752S. Vibrating Steel Bars with Resonators. For demonstrating sympathetic vibrations (sound resonance) and the phenomenon of beats.

Two conditions must exist in order that the vibrating action of one body causes the greatest response in another—the note emitted by the first must be powerful and also resonant with the vibrating period of the second. Caruso was able by singing at the resonant pitch to break thin glasses because of the great power of his voice. Likewise it is the great power of the note emitted by either of these bars that produces such a remarkable response in the other. With only a few feet separating them the responding note is exceedingly loud, while in long corridors it is still quite audible when they are as much as 200 feet apart.

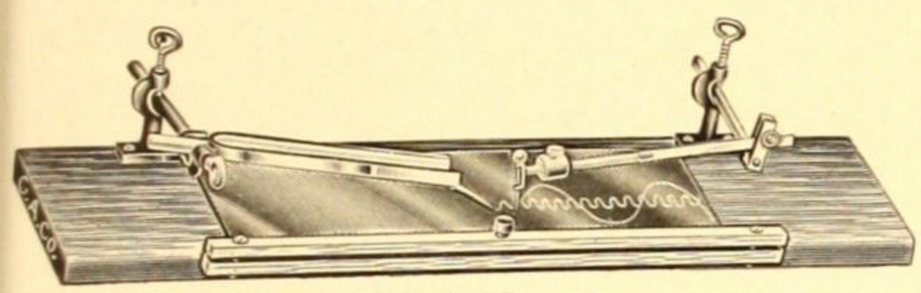
Radio has given to the phenomenon of resonance a new importance. All reception and broadcasting depend on it. Tuning merely makes the electric waves in one circuit resonant with those in another. The human eye is resonant with the wave lengths of the colors of the spectrum but not with those of ultra-violet radiations and hence cannot see the latter. Mechanical resonance exists in spring, pendulum and other suspended systems. In every case the principle is the same. Therefore, these powerful resonating bars also may be used in explaining electrical, light, and mechanical resonance.

In addition, they are useful in demonstrating the phenomenon of beats. A slight difference in frequency—only a fraction of a vibration—exists between the two bars as a result of which a slow pulsating beat occurs when they are struck at the same time.

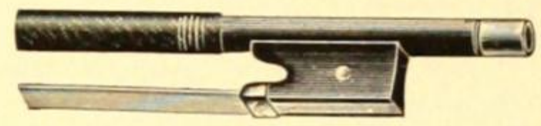
The two steel bars, about 10 inches long, are each mounted on separate and perfectly attuned wooden resonators of the finest quality. Both are closely adjusted to 440 V. P. S. They emit, when struck, a rich, pure, pleasing, long-sustained note possessing tremendous power. Per pair, including two suitable hammers **$15.00**



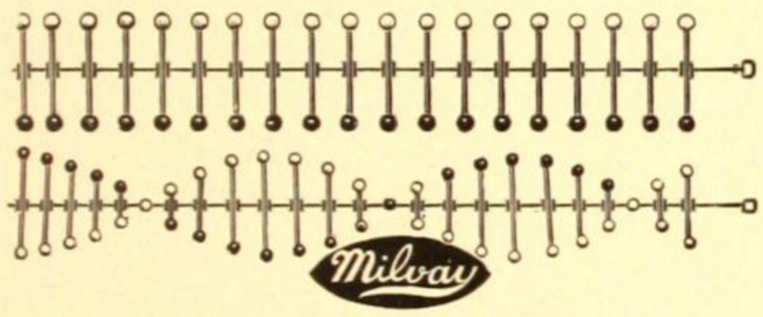
No. 753S.



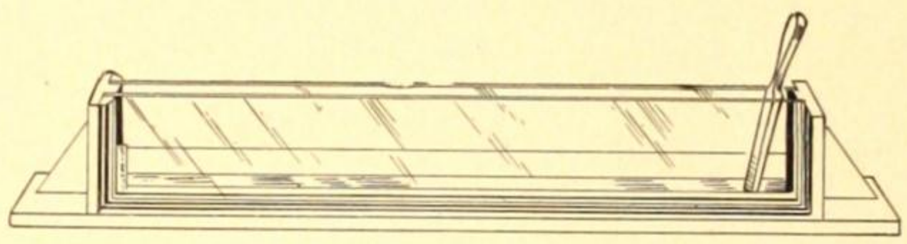
No. 755S.



No. 765S.



No. 775S.



No. 777S.

753S. Vibrating Steel Beat-Note Bars. A set of six special alloy steel bars like No. 752S, precision tuned one vibration apart from A-435 to A-440. While the entire set is mounted on a common base, each bar is provided with an individually tuned resonator. When any two of the bars, for example A-435 and A-437, are sounded simultaneously two pronounced beats or pulsations per second are clearly heard. By sounding the proper bars beat notes at the rate of 1, 2, 3, 4 or 5 per second can be produced with this set. The bars are chromium plated and the base is finished in walnut. Size, 12⅝x11½x4⅛ inches. For producing powerful beats of precise frequencies these bars excel the finest forks made. With hammer and directions....**$30.00**

755S. Vibrograph. For determining the vibration rates of tuning forks. Consists of an improved pendulum bob, the vibration rate of which is adjustable; an adjustable support for clamping the tuning fork; a large glass plate with guide clamp. Mounted on hardwood base, 90x14 cm. Complete, but without tuning fork **$5.50**

760S. Vibrograph Plate. Glass plate only of No. 755S (12.5x35 cm.) **$0.15**

695S. Vibrograph Tuning Fork. Nickel-plated steel, low pitch, large amplitude of vibration; length, about 21 cm., with stylus **$1.25**

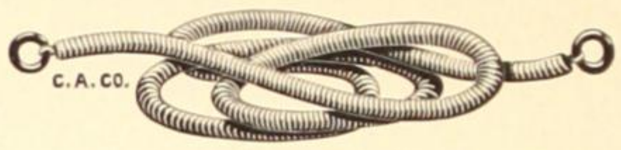
765S. Violin Bow. For use with sonometers, Chladni plates, etc. **$1.50**

775S. Wave Apparatus, Milvay. After Ames and Bliss. Excellent for illustrating the propagation of both transverse and longitudinal waves. Consists of a spring steel strip 10 feet long, to which are attached at regular intervals 20 metal rods carrying balls at each end. In the Milvay, the balls on one side are painted black, on the other white. As a result of this improvement, the motion of the balls can be followed with greater ease. The ends of the strips are provided with rings for suspension. When one end of the strip is attached to a hook in the ceiling and the lower cross-bar twisted out of place, this displacement travels from bar to bar throughout the entire length of the apparatus and illustrates very clearly the propagation of the transverse wave. At the top the wave is reflected, and on reaching the bottom it is again reflected, so that the difference between the reflection at the boundary of a more dense medium and that at the boundary of a less dense medium may be studied. By depressing, in a vertical direction, one end of the lowest cross-bar, a longitudinal wave may be started.....**$12.00**

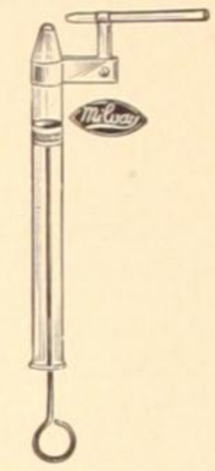
777S. Wave Trough. For studying water waves. Heavy oak with plate glass sides, millimeter depth scale at one end and black line on one glass 10 cm. from bottom. Size of trough 6.3x25x150 cm. Complete with paddle **$40.00**



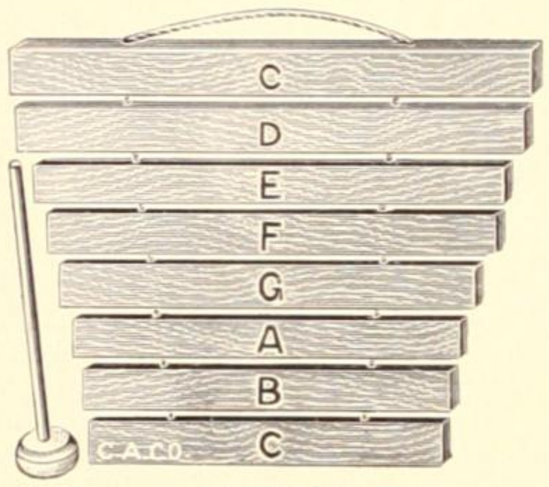
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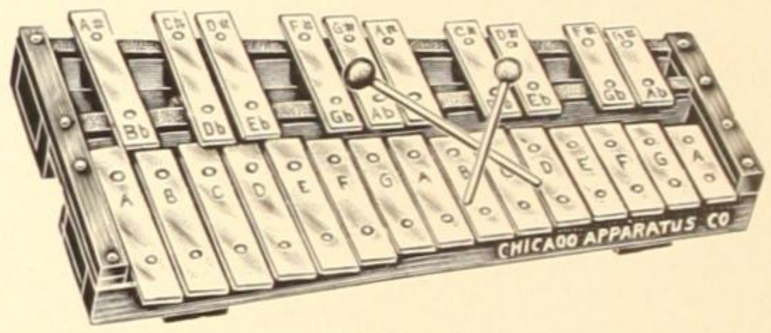
No. 785S.



No. 780S.



No. 790S.



No. 792S.

778S. Whistle, Galton's. For determining the highest audible note. The graduations indicate in 1/10 mm. the length of the vibrating column of air.....**$6.00**

780S. Whistle. As used in Millikan and Gale's Course. For studying the fundamentals of closed pipes. Glass, 25 cm. long, 2 cm. diameter, with sliding piston; glass mouthpiece.....**$1.50**

785S. Wire Spiral. For illustrating progressive wave motion. A helix of brass wire 2 cm. in diameter and 130 cm. long, unstretched, with loop on each end **$2.00**

790S. Xylophone. Eight bars of wood, sounding the octave, suspended by cords, with wooden hammer **$2.25**

792S. Gamut Bells. For demonstrating the exact pitch of each note in the chromatic scale, and therefore, a valuable adjunct in the study of sound in the physical laboratory. It is also an excellent device for use in the teaching of music and for this purpose a large number are now being used with good success in the Chicago schools. Made of the finest tool steel perfectly tuned and producing pure, clear and mellow tones. There are 25 plates, giving two chromatic octaves from A below middle C to the first A above treble staff. Complete with two rubber hammers **$7.50**

Standard Laboratory Supports

The outstanding features of these supports are:

First: Interchangeability. All parts have standard threads, therefore, any parts of our make or any other make with corresponding threads are interchangeable. In other words our tripod designed for our 13 mm. rod

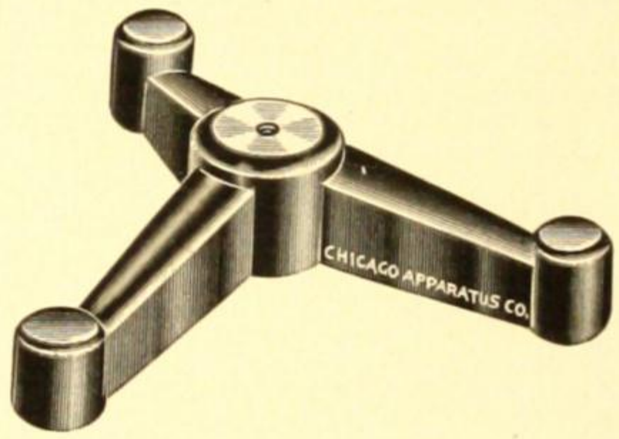
Second: Large Variety. Our line offers a complete of supports for almost every laboratory purpose.

Third: Accuracy. Bases are so faced and rods so shouldered that when screwed together the rod locks securely on the base and stands perpendicular to the surface on which the base rests. The holes and V openings in the clamps are so machined that rods clamped in them will be exactly at right angles to each other or parallel to each other, depending upon the style of clamp employed. Because of this accuracy, elaborate systems can be built up with our supports with every assurance that every rod will take up the proper position with respect to every other rod. This is impossible with clamps made from rough unmachined castings.

Fourth: Durability. Our bases, clamps, and other parts made of cast iron are fully protected by two coats of glossy black baked-on enamel. The support rods and all other steel parts are first copper plated to prevent rusting and then heavily nickel-plated and polished to give them a high-class appearance. These precautions insure the utmost durability. Our supports have been used in many laboratories for over eighteen years and the fact that these supports are still almost as good as new in appearance is proof of the durability and excellence of our finishes.



Nos. 10T-15T.



Nos. 20T-39T.

BASES

Round Pattern

10T. Round Base. Cast iron, black gloss enameled. For 10 mm. rod. Tapped ¼-20. Diameter 15 cm. **$0.35**

15T. Round Base. Same as above, but for 13 mm. rod. Tapped ⅜-16. Diameter 14.3 cm..... **$0.60**

Tripod Pattern

Our tripod bases are made of cast iron and are finely finished in black enamel. The top centre surface is machined so that a rod screwed into it will lock rigidly and stand perpendicular to the supporting plane of the tripod. Tripods suffixed with the letters "LS" are provided with three nickel-plated levelling screws.

Cat. No.	Article	For Rod Diam. mm.	Thread	Length of Leg cm.	Weight, Kilos.	Each
20T.	Tripod Base	10	¼-20	10.8	0.6	$0.50
25T.	Tripod Base	13	⅜-16	13.7	1.2	.70
28T.	Tripod Base	13	⅜-16	15.7	1.9	.90
30T.	Tripod Base	19	½-12	15.7	1.9	1.00
31TLS.	Tripod Base	19	½-12	15.7	1.9	1.75
35T.	Tripod Base	19	½-12	19.8	2.9	1.35
36TLS.	Tripod Base	19	½-12	19.8	2.9	2.10
37T.	Tripod Base	30	¾-10	28	9.5	4.25
38TLS.	Tripod Base	30	¾-10	28	9.5	6.25
39T.	Tripod Base	30	¾-10	42	20.5	10.00
40TLS.	Tripod Base	30	¾-10	42	20.5	12.50

Rods of All Kinds



Nos. 131T-159T.

Made of Bessemer steel, copper-plated to prevent rusting, and nickel-plated. Every rod is square shouldered to fit the facing of bases securely and stand firmly in a perpendicular position. The thread data given below has reference to the diameter of the threaded portion and the number of threads per inch. Any rod will fit any base having the same thread and any rods having the same threads are interchangeable.

Round Rods—10 mm. Diameter

Cat. No.	Article	Length, cm.	Thread	Each
131T.	Support Rod	10	¼-20	$0.20
132T.	Support Rod	15	¼-20	.22
133T.	Support Rod	20	¼-20	.28
134T.	Support Rod	30	¼-20	.35
135T.	Support Rod	40	¼-20	.40

Round Rods—13 mm. Diameter

141T.	Support Rod	20	⅜-16	.30
142T.	Support Rod	40	⅜-16	.45
143T.	Support Rod	60	⅜-16	.50
144T.	Support Rod	80	⅜-16	.75
145T.	Support Rod	100	⅜-16	.90

Round Rods—19 mm. Diameter

Cat. No.	Article	Length, cm.	Thread	Each
151T.	Support Rod	30	½-12	.65
152T.	Support Rod	40	½-12	.75
153T.	Support Rod	60	½-12	.80
154T.	Support Rod	80	½-12	1.10
155T.	Support Rod	100	½-12	1.30
156T.	Support Rod	125	½-12	1.60

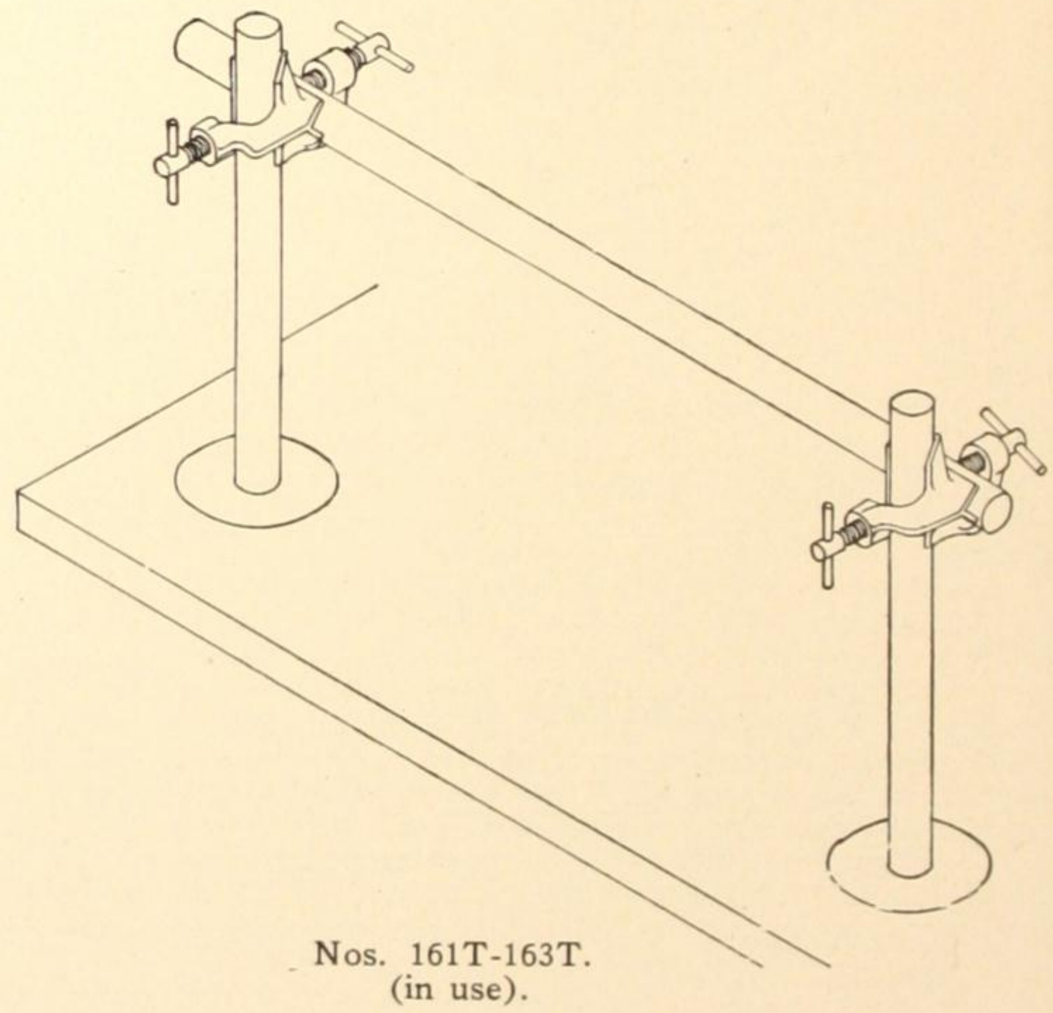
Round Rods—30 mm. Diameter

158T.	Support Rod	100	¾-10	3.75
159T.	Support Rod	160	¾-10	5.50

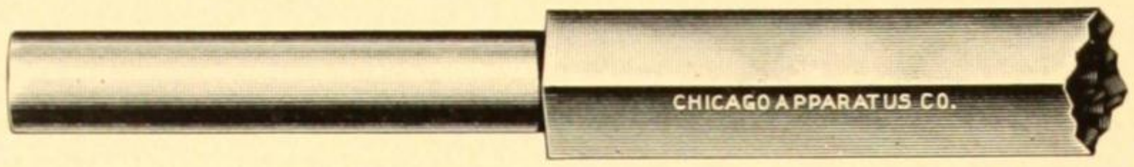
Cross Rods

For use as horizontal rods in connection with two vertical rods mounted in flush plates or table clamps. The support system most commonly employed on laboratory tables consists of: Two No. 113T Flush Plates 19 mm., two 156T Round Rods 125 cm. by 19 mm., two No. 66T Right Angle Clamps, and one No. 162T Cross Rod 125 cm. by 19 mm. Where flush plates are not used the following support system is employed: Two No. 80T Table Clamps, two No. 156T Round Rods 125 cm. by 19 mm., two No. 66T Right Angle Clamps, and one No. 163T Cross Rod 185 cm. by 19 mm. Made of Bessemer steel, copper-plated to prevent rusting and nickel-plated. Both ends of these rods are rounded. Diameter, 19 mm.

Cat. No.	161T	162T	163T
Length, cm.	100	125	185
Each	$1.35	1.65	2.25



Nos. 161T-163T. (in use).



Nos. 174T-175T.



No. 472K.

Square Rods—19x10 mm.

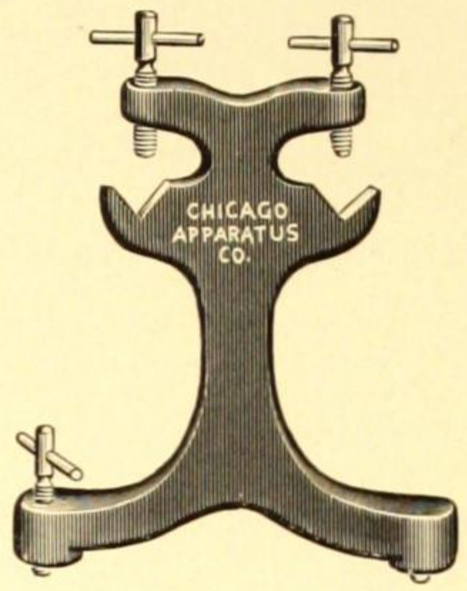
One end is turned to diameter of 19 mm. for a distance of 6.5 cm. Useful in connection with No. 472K and No. 474K End Supports for building horizontal photometer and optical benches, the rounded portion permitting the support attached to it to be adjusted so as to take the wobble out of the bench when not resting on a perfectly level surface. Heavily coppered, nickel-plated and polished.

Cat. No.	174T	175T
Length above shoulder, cm.	120	220
Each	**$5.00**	**8.25**

Graduated Rods—19x19 mm.

Same as above, but graduated in millimeters, each centimeter being numbered.

Cat. No.	452K	453K
Length above shoulder, cm.	120	220
Length graduated portion, cm.	100	200
Each	**$12.75**	**18.00**

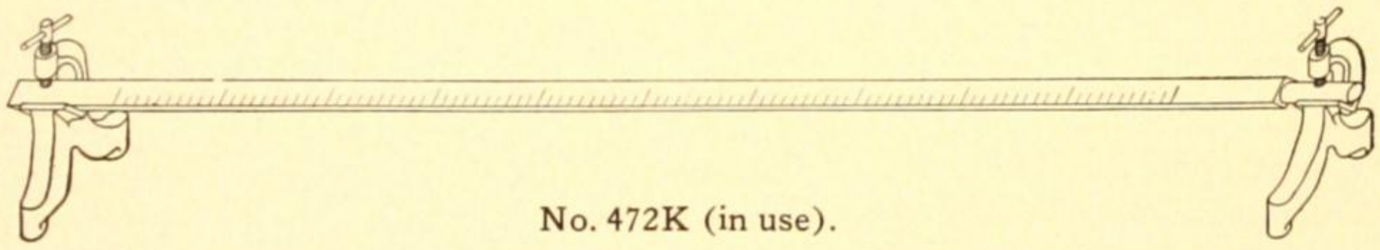


No. 474K.

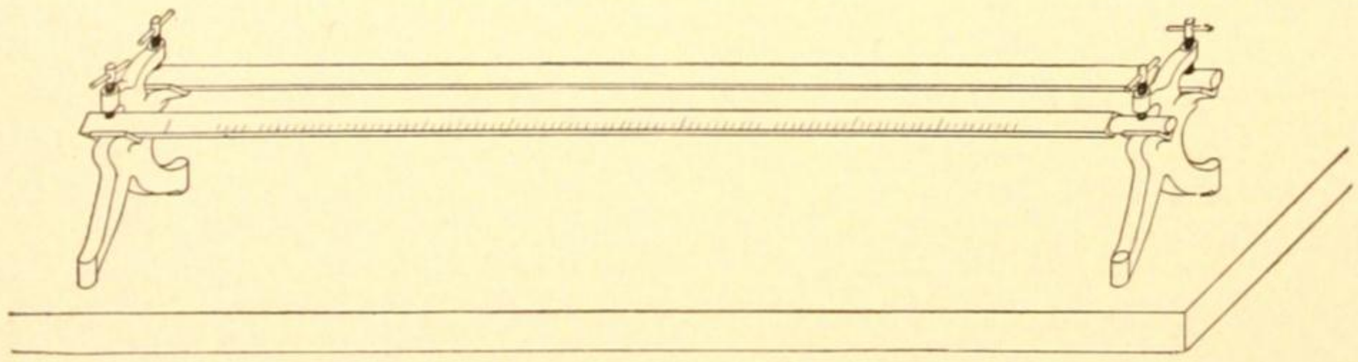
End Supports

472K. Support, End. For holding Graduated Rods Nos. 452K and 453K rigidly in a horizontal position. Two are required to build up an optical bench. Made of cast iron, japanned. **Each**.....**$0.90**

474K. Supports, End. Will hold two 19 mm. round or square rods 7.5 cm. apart and 15 cm. above table. Useful for building up double rod optical benches. One support is provided with a nickel-plated leveling screw. **Per pair**.....**$5.00**

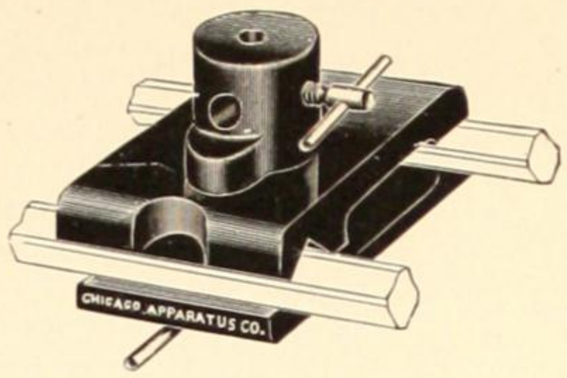


No. 472K (in use).

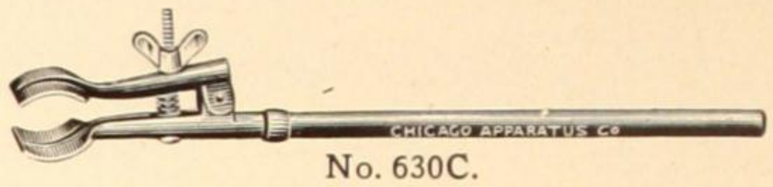


No. 474K (in use).

CLAMPS OF ALL KINDS



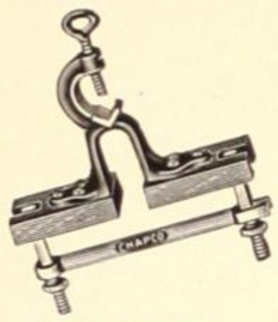
No. 44T.



No. 630C.



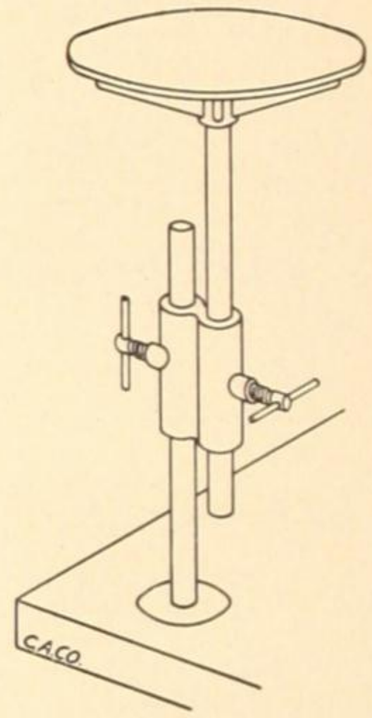
Nos. 715C-720C.



No. 443E.



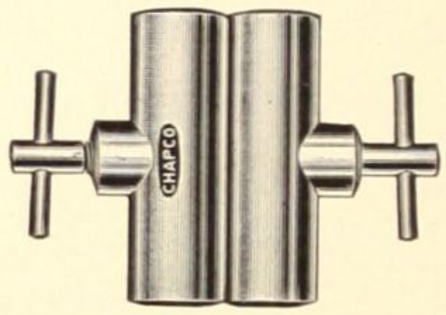
No. 448E.



No. 51T (in use).



No. 45T.



No. 51T.

44T. Clamp, Bridge Form. For use on optical benches and photometers made up of two 19 mm. square rods held 7.5 cm. apart in end supports like our No. 474K. Has position index, vertical hole 10 mm. in diameter, and lateral hole 13 mm. in diameter. Black gloss enameled, nickel-plated screws.....**$5.25**

630C. Clamp, Condenser. With adjustable jaw. For supporting barometer tubes, Boyle's law tubes, etc. This clamp is shown in use in Support No. 211T. Will hold objects 40 mm. in diameter. Mounted on 8 mm. x 30 cm. nickel-plated rod.....**$0.60**

715C. Clamp, Condenser, Universal, Small. Iron finished in black japan. For condensers, etc., the jaws adapt themselves to irregular objects. For objects 1¾ inches or less in diameter. Rod 6 inches long, ⅜ inch diameter; for fastening to rod of support by means of our No. 665C Clamp Holder.....**$0.60**

720C. Clamp, Condenser, Universal, Large. Same as No. 715C, but for objects 2½ inches or less in diameter. Rod 6¼ inches long, diameter ½ inch....**$0.80**

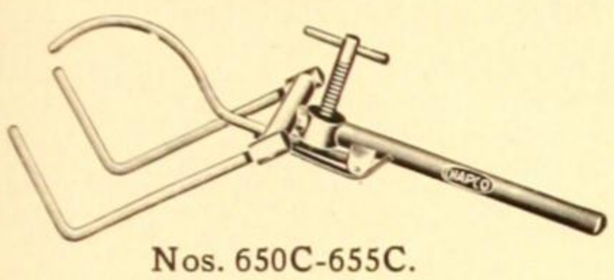
443E. Clamp, Electrolysis Apparatus. For clamping any form of electrolysis apparatus like our No. 424E, No. 428E, No. 433E or No. 438E to a support rod ¾ inch or less in diameter. The most satisfactory clamp of its kind on the market. Grips and holds the apparatus firmly without danger of breakage **$2.50**

448E. Clamp, Electrolysis Apparatus Connector. Consists of insulating bar with two double binding posts. Provided with clamp for attaching to support rod 19 mm. or less in diameter. Excellent for use in connecting sources of current with electrolysis apparatus. It takes the strain off the electrodes, thus protecting them against injury.....**$1.50**

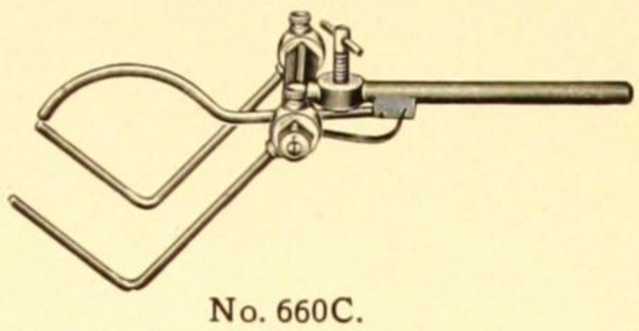
45T. Clamp, Extension or Parallel. With two V-openings. For clamping rods of the same or different diameter parallel to each other. Also for extending the height of supports by clamping one rod above another. Fits rods from 10 to 19 mm. diameter. Black gloss enamel, nickel-plated screws.....**$1.00**

51T. Clamps, Extension or Parallel. With Two Round Holes. Same as No. 45T, but more compact. Will hold rods more rigidly. Black gloss enamel, nickel-plated screws. Made in three sizes:

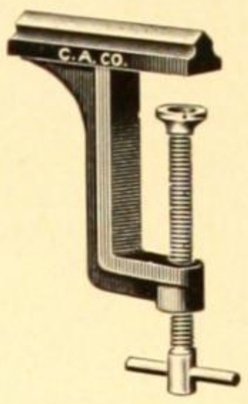
Cat. No.	51T	52T	53T
For rods of diameter, mm....	10	13	19
Each	**$0.75**	**.85**	**1.40**



Nos. 650C-655C.



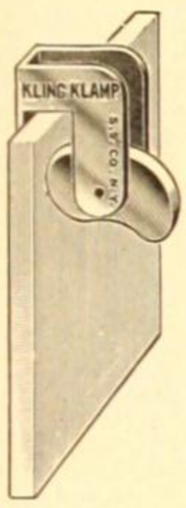
No. 660C.



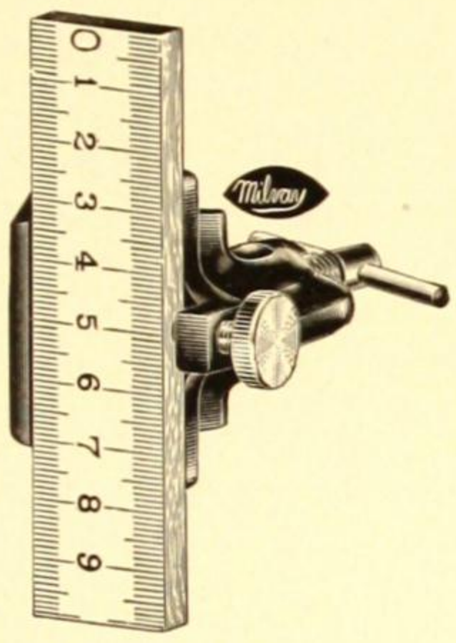
No. 365S.



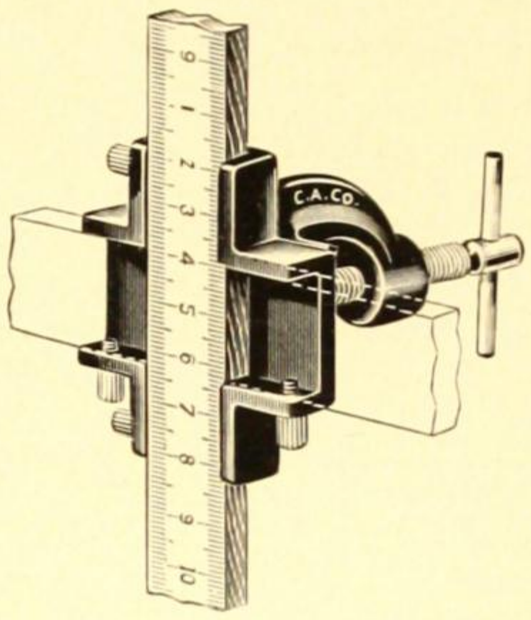
No. 54T.



No. 70W.



No. 55T.



No. 49T.



No. 407K.

650C. Clamp, Holdawl, Small. Made of iron and steel, finished in black Japan, nickel-plated screw. Meets practically every laboratory requirement. Holds condensers, small or large tubes, funnels, bottles, flasks, test tubes, telescopes, meter sticks, etc. Rubber tubing can be easily slipped over jaws to protect delicate glassware. To facilitate clamping the movable jaw is made to open automatically as the screw is turned back. Will clamp any object up to 2¼ inches in diameter; distance between end jaws, 3¼ inches; rod 6 inches long and $\frac{7}{16}$ inch in diameter; for fastening to support by means of our No. 665C Clamp Holder.....**$1.65**

655C. Clamp, Holdawl, Large. Same as No. 650C, but for clamping articles up to 3¼ inches in diameter; distance between end jaws, 5¼ inches; rod 6x½ inches **$2.25**

660C. Clamp, Holdawl, Adjustable. Similar to above clamps, but constructed so that distance between end jaws can be varied from 1½ to 6 inches. For clamping objects up to 3¼ inches in diameter; rod 6 inches long and ½ inch in diameter.....**$4.50**

365S. Clamp, Knife Edge. Has metal prism 8 cm. long provided with clamp to fit table tops 6.5 cm. thick or less. Will hold its edge and therefore superior to wood prism. Designed to project beyond edge of table top so weight pan may be suspended from test rod without drilling hole in table top.**$0.75**

54T. Knife Edge Rod. For use as a knife edge support in connection with No. 85T Table Clamp. 10 cm. long x 13 mm. square. Half the length is turned to 13 mm. diameter so that the rod may be rotated in the clamp to any desired position. Nickel-plated **$0.60**

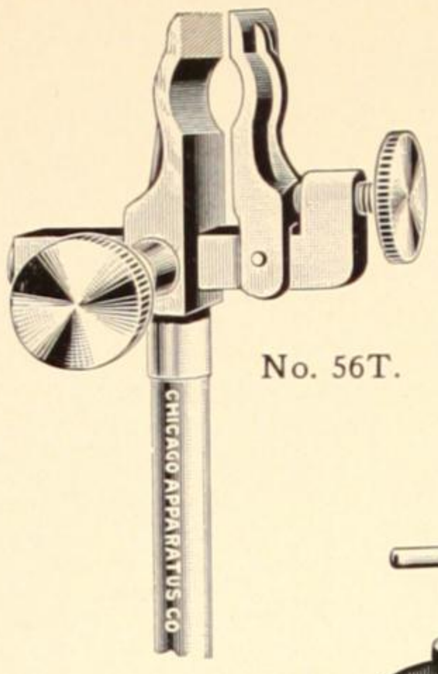
70W. Clamp, Kling. For holding charts, maps, pictures, bulletins, books, etc. The greater the pull or weight the more tightly the cam grips the object. Securely holds the thinnest sheet of paper as well as objects up to ⅜ in. thick. The most useful clamp on the market. Complete with screws for attaching to walls or bulletin boards.....**Per pair $0.50**

55T. Clamp, Meter Stick, Milvay One-Way Form. For holding a meter stick or other scale about 26 mm. wide by 6 mm. thick parallel to a support rod. Will clamp on any support rod 8 to 19 mm. in diameter. Face of meter stick is held about 2.5 cm. from center of support rod. Black enameled with nickel plated screws **$0.65**

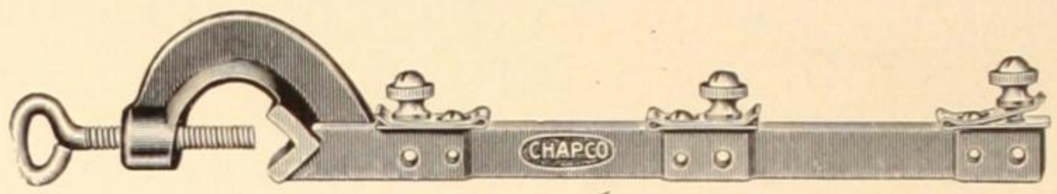
49T. Clamp, Meter Stick, Milvay Two-Way Form. For holding a meter stick or other scale about 26 mm. wide by 6 mm. thick either vertically or horizontally. Will clamp on any support rod 8 to 19 mm. in diameter. Face of meter stick is held about 3 cm. from center of support rod. Black enameled with nickel plated screws.....**$1.25**

407K. Clamps, Optical Bench. For holding lens holders, screens, illuminants, etc., vertically on optical benches. With central indicator which will be found valuable in quantitative work with graduated optical benches. The V-groove is extra wide, allowing clamp with accessory attached to slide easily along the bench rod. These clamps are shown in use in illustration No. 472K. Black gloss enamel, nickel-plated screws. Made in two sizes.

Cat. No.	407K	408K
Hole for rods of diam., mm	10	13
V-Opening for sq. rods of diam., mm	19	19
Each	**$1.00**	**1.65**



No. 56T.



No. 794R.



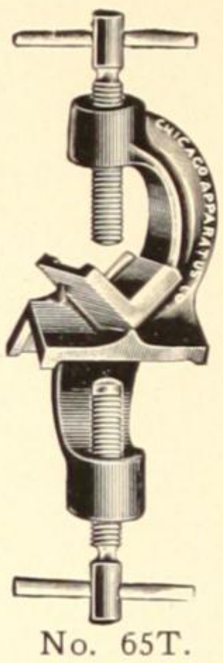
No. 795R.



No. 57T.



No. 58T.



No. 65T.



No. 70T.



No. 72T.

56T. Clamp, Parallel-Jaw. Brass, nickel-plated, with inner surfaces of jaws file cut. Convenient for holding square or round objects such as: balls, mirrors, scales, burettes, glass tubes, etc. One jaw is pivoted and its angular position with reference to the other is adjustable by thumb-screw. Spring pressure causes this pivoted jaw to open automatically when the thumb-screw is turned back. Maximum opening of jaws, 5 cm. Mounted on rod 10 mm. diameter x 25 cm. long **$2.85**

794R. Clamp, Pendulum, Metal. New Model. Grips and holds the finest thread as securely as a heavy cord. Slipping is impossible. Edges of clips match perfectly. This gives exact points of suspensions and makes it easy to determine exact lengths of pendulums. Upon turning the thumb-screw the vise-like clips open automatically. The insertion of suspensions and adjustments as to length can therefore be accomplished with utmost ease. Has none of the disadvantages of other makes—no loose plates to slip out of their guide pins—no indefinite points of suspension. Can be used on any vertical or horizontal support rod 19 mm. or less in diameter. Clamp and arm are of iron—black enameled; clips and thumbscrew are finished in white nickel-plate **$1.00**

795R. Clamp, Pendulum, of Wood. Jaws are held together by two brass thumb-screws. Total length, 30 cm. **$0.45**

57T. Clamp, Right Angle with Two Round Holes. Brass, nickel-plated, for holding two 10 mm. rods exactly at right angles to each other..... **$0.75**

58T. Clamps, Right Angle. With V-Opening and Round Hole. For holding two rods at right angles. Nos. 58T and 60T are extensively used on optical benches and are therefore provided with position indicator.

Cat. No.	58T	59T	60T	61T
Hole for rods of diam., mm.	6	10	13	19
V-Opening for rods of diam., mm.	19	13	19	30
Each	**$1.25**	.75	.90	1.75

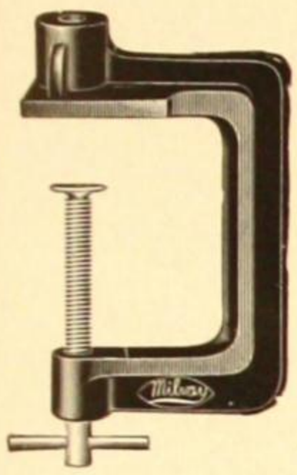
65T. Clamps, Right Angle. With Two V-Openings. For clamping rods at right angle to each other. Shown in use in illustration No. 211T. Black, gloss enamel, nickel-plated screws. Made in two sizes:

Cat. No.	65T	66T
For rods up to diam., mm.....	13	19
Each	**$0.80**	.95

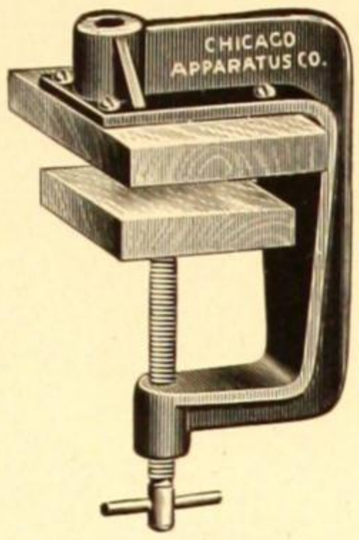
70T. Clamp, Swivel or Universal. With two V-Openings. For clamping two rods at any desired angle. May also be used as an Extension Clamp, Parallel Clamp or Right Angle Clamp. Especially useful for supporting mirrors, pulleys, and lens supports in any conceivable position. Fits all rods from 10 to 19 mm. in diameter. Black gloss enameled, nickel-plated screws **$2.00**

72T. Clamps, T-Type. For two rods of equal diameter at right angles in the same plane. Black gloss enameled, nickel-plated screws

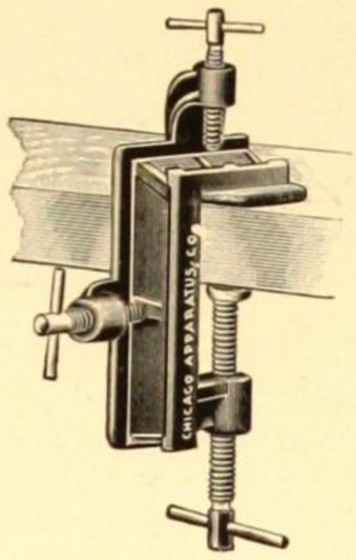
Cat. No.	72T	73T
For rods up to diam., mm.....	13	19
Each	**$1.00**	1.50



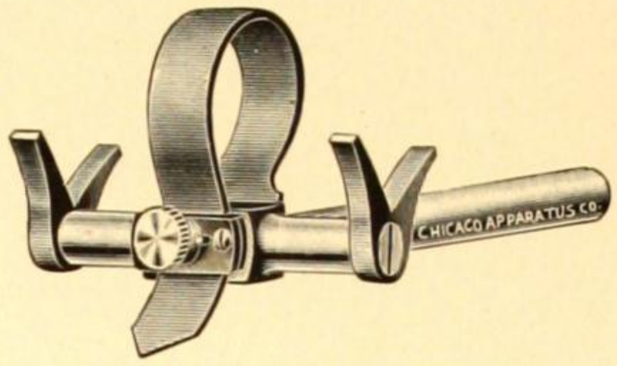
No. 75T.



No. 80T.



No. 85T.



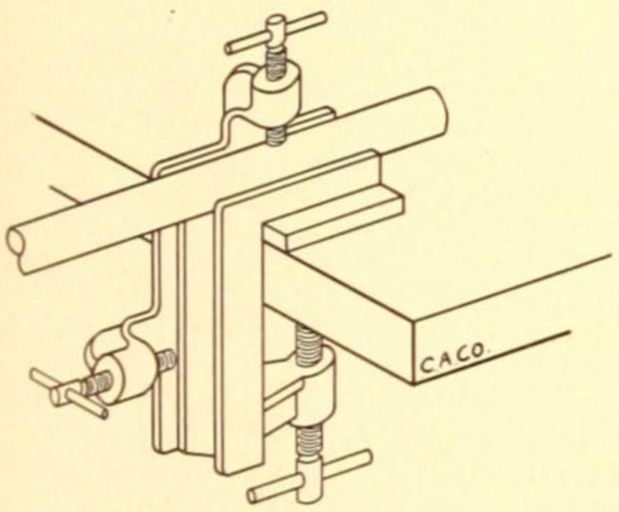
No. 87T.

75T. Clamp, Table. With Broad Flange. For clamping to the edge of a table top 10 cm. thick or less and for supporting a 13 mm. rod in a vertical position. The extra large flange—about 6.5x8.5 cm. —does not mar the top and gives increased stability. Shown in use in illustration No. 174B. **$0.85**

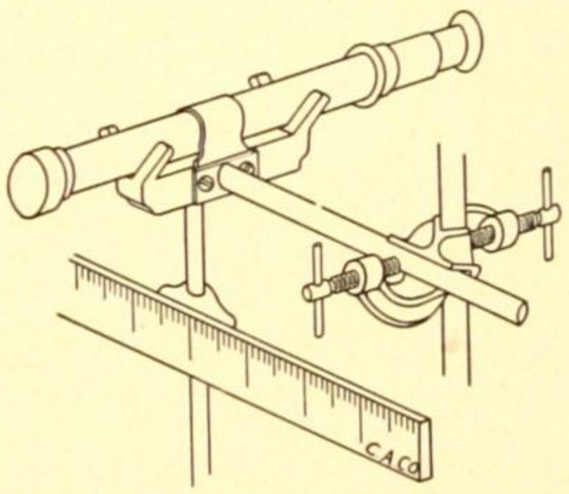
80T. Clamp, Table. With Broad Wooden Jaws. Designed for clamping to edge of a table top—8.5 cm. thick or less—and for supporting a 19 mm. rod in a vertical position. The extra large jaws—top and bottom—impart the greatest possible stability and prevent injury to the table top. Two of these clamps, two No. 156T—125 cm. x 19 mm. Rods, two No. 66T Right Angle Clamps and one No. 162T Cross Rod 125 cm. x 19 mm. is standard equipment on many physics tables. Black gloss enameled, nickel-plated screws **$2.75**

85T. Clamp, Table. With Two V-Openings. For table top 8 cm. thick or less. For holding 10, 13, or 19 mm. round or square rods. Under side of upper jaw is ground smooth—will not injure table top. The vertical V-groove is 13 cm. long, the horizontal 7.5 cm., hence they will hold rods rigidly in either plane. Made of japanned iron, nickel-plated screws **$2.40**

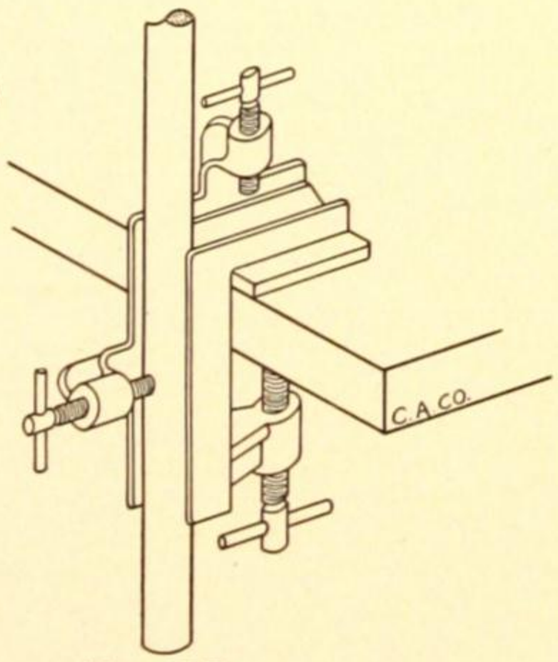
87T. Clamp Telescope. For holding telescopes and other round or square objects, from 2 to 5 cm. in diameter, liable to be injured by too great pressure. A soft leather strap holds objects securely. The bottom of the clamp is also tapped for a support rod 10 mm. in diameter for carrying a scale. Mounted on a nickel-plated steel rod 20 cm. long and 13 mm. diameter; all other parts are made of brass.... **$4.00**



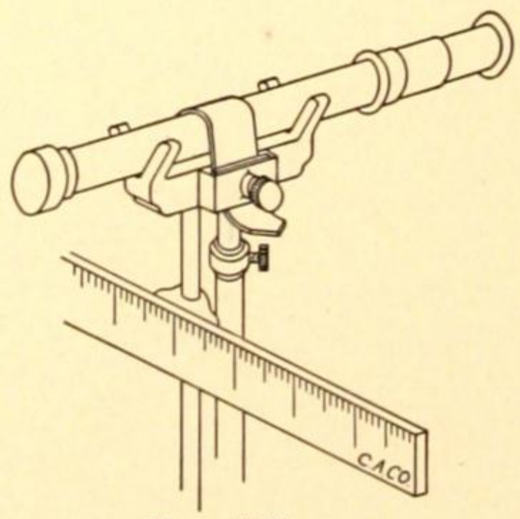
No. 85T.
(Holding a rod in horizontal position)



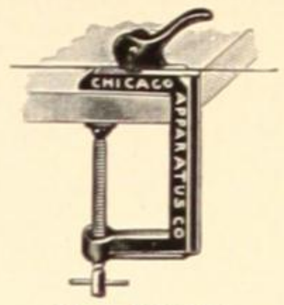
No. 87T. (In use on ordinary laboratory support)



No. 85T.
(Holding a rod in vertical position)



No. 87T.
(In use on stand tube support)



No. 1009R.



No. 1011R.

1009R. Clamp, Tension, Stone's. Improved form. For use in experiments on composition of forces, resultant of concurring forces, error of spring balance, laws of lever and other experiments in which it is necessary to maintain a strain on a wire or cord. An eccentric lever clamps the cord or wire securely, and when raised allows the tension to be easily reduced or increased. Black gloss enameled iron, nickel-plated screw. Fits table top 7 cm. thick or less **$0.80**

1011R. Clamp, Tension, Milvay, New Adjustable Form. The old eccentric lever types have two drawbacks:

1. The tremendous leverage so easily applied cuts the string.
2. The height of the string above the table cannot be varied.

In the Milvay the broad locking surfaces make it impossible to cut the string no matter how much pressure is applied. The height of the string above the table can be varied through a range of 5 cm. so that it will lie parallel to the table and close to the paper. Your students will, therefore, get better results in their work on composition of forces, resultant of concurring forces, etc. The new string locking device also affords an easier, quicker and nicer means of adjusting the tension. Made entirely of metal, finished in black enamel, fits table tops 7 cm. thick or less **$1.25**

Plain Collars with Set Screw

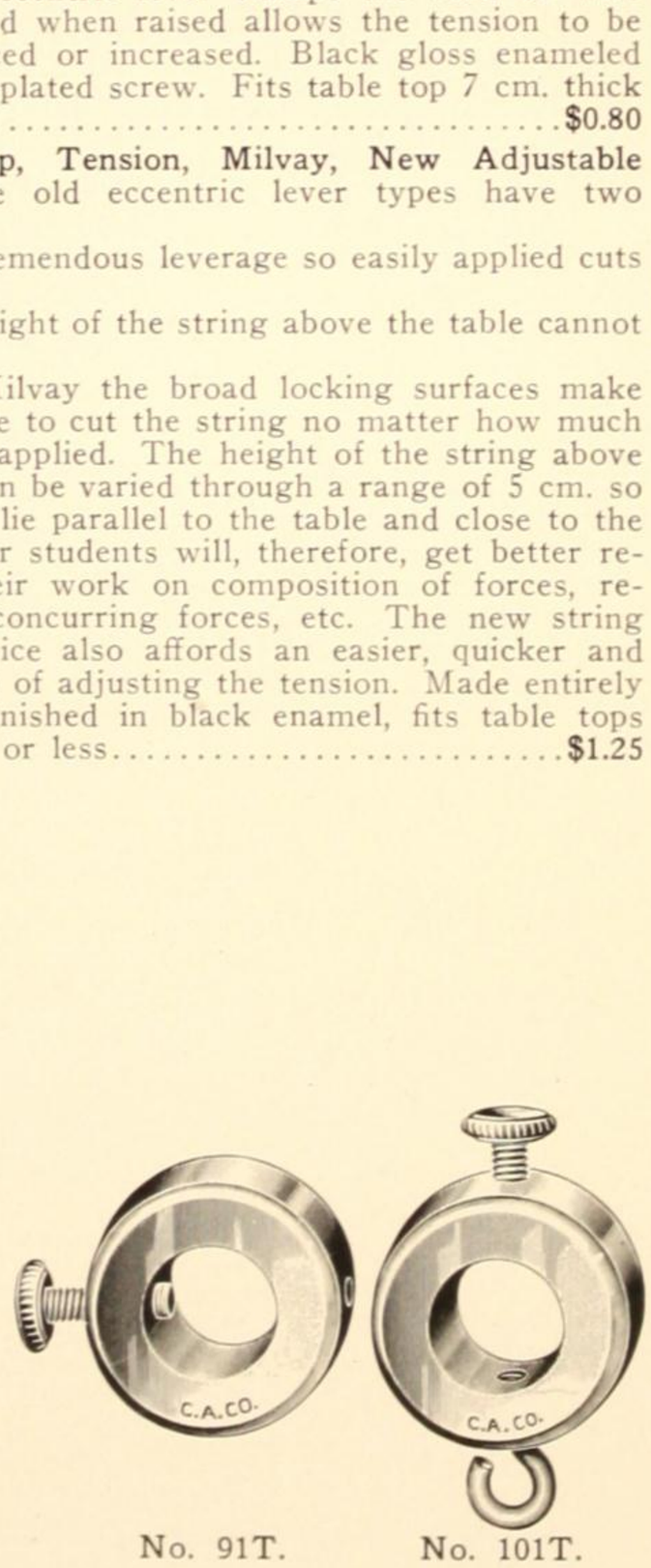
For clamping on support rods beneath telescope clamps, platforms, etc., to prevent change in their vertical adjustment while they are being moved about in a horizontal plane. All sizes of brass, nickel-plated.

Cat. No.	91T	92T	93T
For rods of diameter, mm.....	10	13	19
Each	**$0.60**	.65	.70

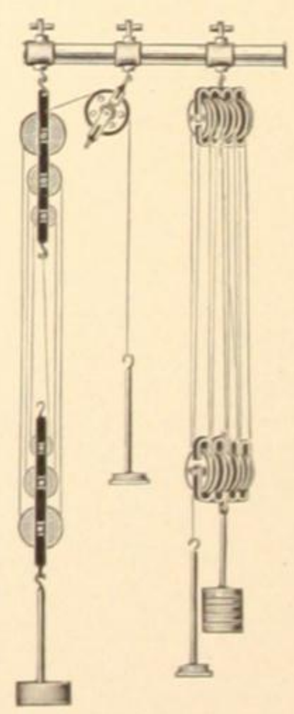
Hook Collars with Set Screw

These are a great convenience in pulley experiments. They permit quick assembly and adjustment of pulley combinations on the cross rods of any laboratory support system. Unlike other makes, our hook collars because of their heavy bodies, accurate faces, and removable hooks may also be used as plain collars to prevent change in the vertical adjustment of telescope clamps and platforms while they are being moved about in a horizontal plane. All sizes of brass with nickel finish.

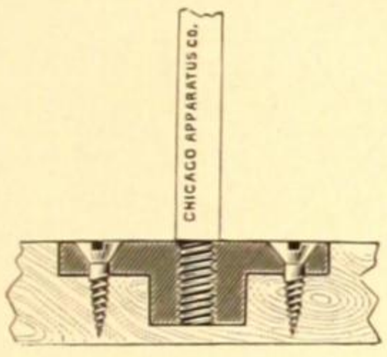
Cat. No.	101T	102T	103T	104T
For rods of diameter, mm.....	10	13	19	30
Each	**$0.75**	.80	.85	1.50



No. 91T. No. 101T.



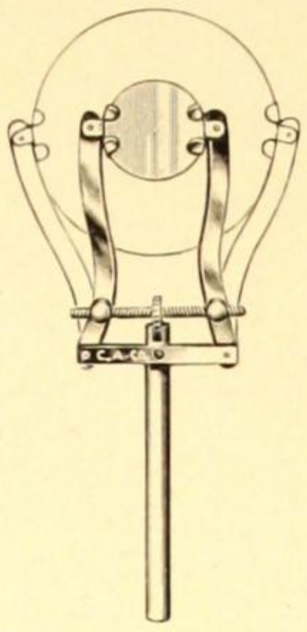
Nos. 101T-104T (in use).



Nos. 111T-113T.



No. 425K.



No. 424K.



No. 115T.

Flush Plates

111T. Flush Plates. Brass (non-magnetic), nickel-plated, polished top. For holding support rods perpendicular to the table top. Designed to be set flush in the table top. Price includes necessary screws.

Cat. No.	111T	112T	113T
Diameter, mm.	35	48	70
For rods of diameter, mm.	10	13	19
Size of thread	¼-20	⅜-16	½-12
Each	**$0.60**	**.70**	**1.25**

Lens Holders

425K. Lens Holder, Farwell-Stifler. Universal in the strictest sense of the word. Spring pressure applied against the movable jaw securely holds any lens, screen or mirror up to 75 mm. in diameter. Both jaws have deep V-grooves in them. These V-grooves automatically align screens, lenses, or mirrors in the central plane of the holder, which plane coincides with the index line on the clamp holder. In view of this construction the optical distance between lenses, mirrors and screens are accurately indicated on the graduated bench rod and accounts for the excellent results obtained when these holders are employed. It will also be noted that the sides and jaws of the holder, being straight, form a perfect rectangle, the base of which 75 mm., being twice the width of screens most commonly employed in optical experiments. This permits of placing the screens on either the right or left half side of the holder—an essential requirement in an experiment on the focal points of thin convex lenses, etc. No lens holder offers so many advantages. Mounted on a 10 mm. x 15 cm rod. . **$1.25**

424K. Milvay Universal Screw-Action Lens Holder. Physics teachers familiar with the shortcoming of other lens holders will quickly recognize the exceptional merits of this new type designed by us after an exhaustive study of all other forms.

1. The full and simultaneous motion of both jaws is controlled by a few turns of a single thumb wheel.

2. It is easily manipulated with one hand, leaving the other free for the insertion or removal of the lens or other object.

3. It holds every object, regardless of size, firmly and securely with a tension always under the full control of the operator.

4. There are no springs, hence no uncertainty or variation in the grip on different sized objects.

5. It will hold any size lens, mirror, grating, or screen from 25 to 100 mm. in diameter.

6. It will hold square as well as round objects.

7. It will hold thick edge as well as thin edge objects.

8. It will always, regardless of size, hold all objects with their optical axes very closely in the same position.

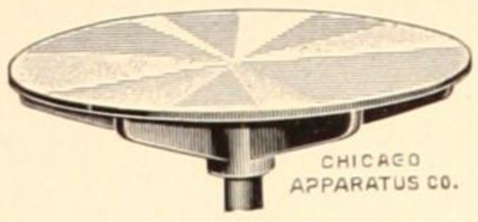
9. It has no awkward or clumsy projecting parts so bothersome in other forms, especially when holding small lenses, mirrors, etc.

10. It is a perfectly symmetrical holder consisting of a minimum of parts, hence very compact and extremely pleasing in appearance.

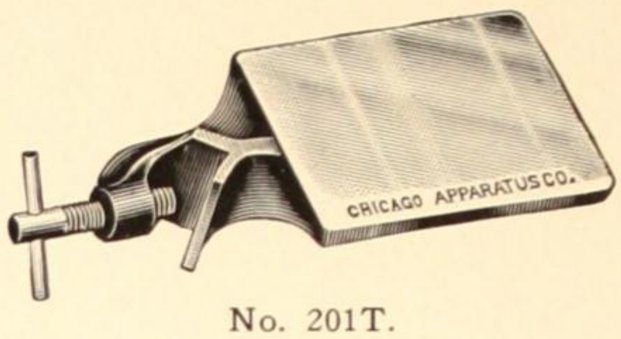
Made of brass, finished in optical black and mounted upon a nickel-plated steel rod 10 mm. diameter by 15 cm. long. The excellent design, fine construction, elegant appearance and great convenience of this new lens holder will appeal to the most critical buyer and user of physical apparatus **$2.00**

Leveling Screws

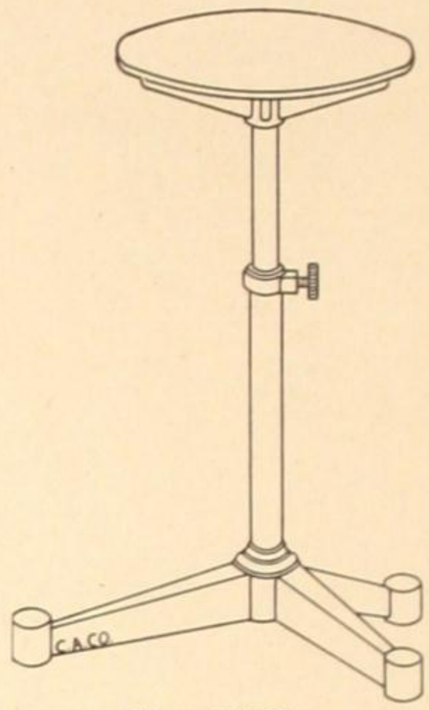
115T. Leveling Screws. Black gloss enameled iron base, nickel-plated screw. Range of adjustment from 50 to 75 mm. Convenient for accurately leveling any board or glass plate holding apparatus. **Per set of three** **$3.50**



No. 180T.



No. 201T.



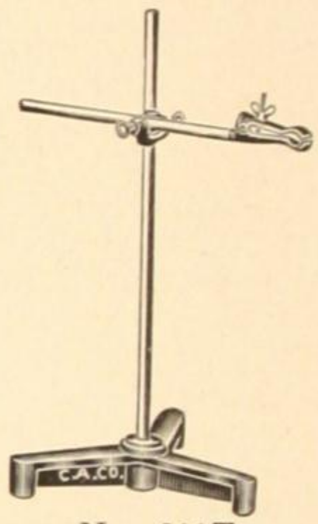
No. 210T.



No. 185T.



Nos. 205T-206T.



No. 211T.

Stand Tops and Stand Tubes

180T. Stand Top. Round iron pattern, 15 cm. diameter. Turned true on top and edge and tapped to fit on end of a 13 mm. Support Rod. With this top, a No. 25T Tripod, No. 141T Rod, No. 185T Stand Tube, an excellent adjustable stand for supporting heavy objects is readily constructed. Underside of top is finished in black gloss enamel..... **$2.50**

185T. Stand Tube. A hollow brass nickel-plated tube 20 cm. long, designed to take a 13 mm. Support Rod and lock it at any desired height. At the lower end of this tube is a threaded piece that fits any tripod designed for a 13 mm. rod. Useful in building up small tables and stands **$4.00**

Table Platforms

196T. Table Platform. Round form, diameter 12.5 cm., with V-groove for 10, 13 or 19 mm. rods. Excellent for supporting tumblers, etc. Japanned iron, nickel-plated screw **$0.75**

201T. Table Platforms. Of japanned iron. Top surface ground smooth and true. The V-groove on all our platforms is for either 10, 13 or 19 mm. rods.

Cat. No.	201T	202T	203T
Size of top, cm.	6x9	9x13	12x18
Each	**$1.00**	1.20	2.00

V-Shaped Supports

205T. V-Shaped Supports. Useful for supporting telescopes and other objects in a horizontal position. Made of brass neatly finished, in two sizes.

Cat. No.	205T	206T
For objects up to diameter of, cm.	6	15
Clamps on rods up to diameter of, mm.	13	19
Each	**$0.70**	1.25

Complete Support Stands

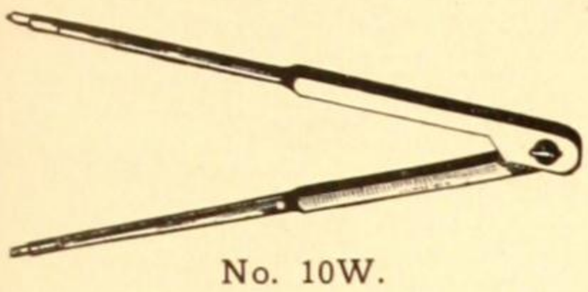
210T. Stand, Adjustable. Consists of No. 180T Stand Top, No. 185T Stand Tube, No. 141T Rod, 13 mm. by 20 cm., No. 25T Tripod. Ideal for supporting heavy apparatus from 25 to 40 cm. above table. **$7.50**

211T. Support, M. G. & B. As used in Millikan, Gale and Bishop's Course. Consists of heavy tripod base, 10 mm. by 60 cm. nickel-plated support rod, right angle clamp and adjustable condenser clamp mounted on a 30 cm. nickel-plated rod **$2.25**

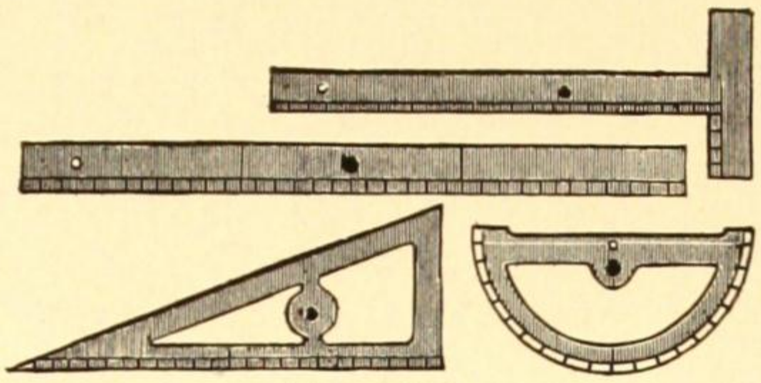
1615C. Support, Hardwood, Schellbach's Universal. Cork lined clamp with Universal movement and adjustable up and down for a range of about 4 inches. Illustrated in Chemical Apparatus section..... **$2.25**

1620C. Support, Hardwood, Gay-Lussac's Improved Form. Cork lined clamp with 22x½ inch rod. Illustrated in Chemical Apparatus section **$2.00**

Miscellaneous Supplies



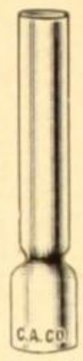
No. 10W.



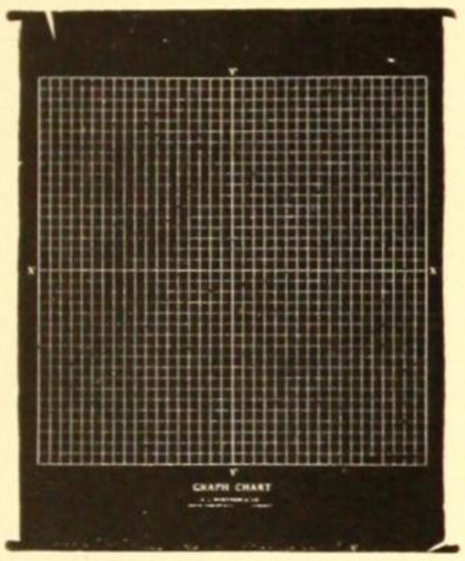
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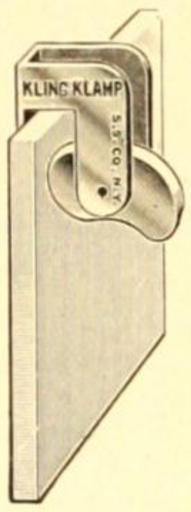
No. 60W.



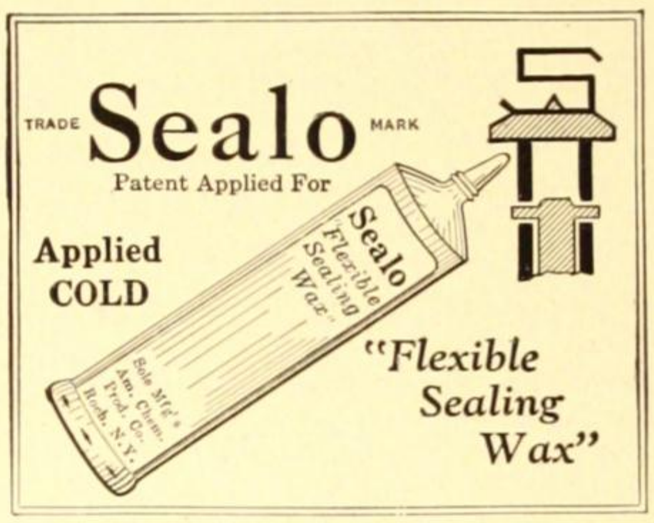
No. 65W.



No. 50W.



No. 70W.



No. 604C.

5W. Acid Proof Finish. For making the wooden tops of laboratory tables practically acid proof. The finished top will be black. This finish has been used with good success for many years. One gallon covers about 300 square feet. Consists of two solutions. **Per gallon** (½ gallon of each solution).....**$2.75**

10W. Blackboard Compass. Made of hard maple, polished, with rubber foot and adjustable crayon holder, length 17 inches. Screw adjustment at top works perfectly and holds compass at any spread desired **$0.90**

15W. Blackboard Drawing Set. Consists of 24-inch T-square, 30-inch Straight Edge, 18-inch Triangle, all divided into inches, and 14-inch protractor..**$6.00**

20W. Blue Print Paper. In 10-yard rolls 30 inches wide. **Per roll**.....**$1.25**
Blue Print Paper in pkgs. is listed in Physical Apparatus—Magnetism Section.

25W. Cement, DeKhotinsky, Laboratory, Hard. For cementing glass, metal, porcelain, etc.
Per ounce **$0.75**
Per pound **9.50**

30W. Cement, DeKhotinsky, Laboratory, Medium. For cementing and insulating purposes.
Per ounce **$0.75**
Per pound **9.50**

35W. Cement, DeKhotinsky, Laboratory, Soft. For insulating and covering electric wires, for cementing rubber, wood, ivory, etc.
Per ounce **$0.75**
Per pound **9.50**

604C. Cement, Sealo. For sealing joints in condensers, extraction apparatus, other set-ups, distillation apparatus, gas analysis apparatus, vacuum pump connections, etc. Also for sealing museum jars, culture tubes, culture jars and plates; mounting botanical specimens; cementing and insulating wires, etc. Seals all joints leakproof. It is waterproof, flexible, insoluble, insulating, adhesive, non-inflammable, and melts at 400° F. Sets on contact with air and dries hard in a few minutes. **Per ounce tube**.....**$0.25**

40W. Chamois Skin. For cleaning instruments, etc. About 9x11 inches **$0.25**

45W. Chamois Skin. About 14x18 inches..... **1.00**

50W. Chart, Graph. Made of best grade slated canvas, with just the right "bite" to take chalk. Guaranteed not to crack. Size of chart 39x50 inches, size of graph 36x36 inches, heavy central lines; lines are one inch apart and form one inch square. On plain mouldings top and bottom **$5.25**

55W. Cheese Cloth. Standard quality, 36 inches wide. **Per yard** **$0.15**

60W. Chimney, Argand. Glass, cylindrical, diameter $1\frac{13}{16}$ inches, height 8 inches **$0.15**

65W. Chimney, Student Lamp. Glass, bottom diameter $1\frac{7}{8}$ inches, top diameter $1\frac{3}{8}$ inches, height $10\frac{1}{2}$ inches.....**$0.25**

70W. Clamp, Kling. For holding charts, maps, pictures, bulletins, books, etc. The greater the pull or weight the more tightly the cam grips the object. Securely holds the thinnest sheet of paper as well as objects up to $\frac{3}{8}$ in. thick. The most useful clamp on the market. Complete with screws for attaching to walls or bulletin boards. **Per pair**.....**$0.50**



No. 95W.



No. 80W.



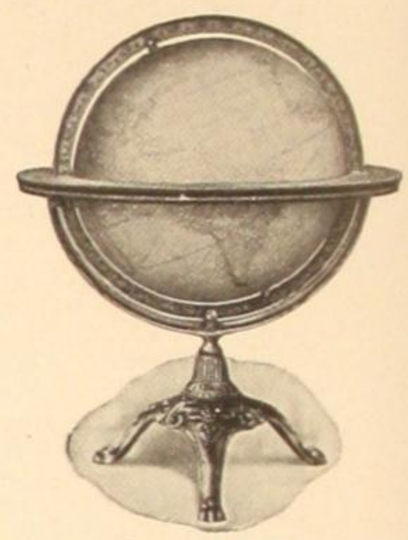
No. 130W.



No. 135W.



No. 140W.



No. 145W.

75W. Cloth, Turkey Red. Per yard **$0.25**

80W. Cord. Chalk Line. Mason's $\frac{1}{16}$ inch, in hanks of 20 feet. **Per hank** **$0.10**

884R. Cord. Fish Line. Cotton, hard braided, black and gold color, 25 yards on card. **Per card** **$0.25**

889R. Cord. Twisted Flax. Extra fine quality, useful in pulley experiments. **Per ½-lb. ball** **$1.00**

85W. Emery Cloth. In sheets 9x11 inches.

Abrasive No.	000	00	0	1	2
Per sheet	**$0.12**	.12	.12	.12	.16
Per quire	**$2.50**	2.50	2.50	2.50	3.25

90W. Emery Paper. In sheets 9x11 inches.

Abrasive No.	00	0	1
Per sheet	**$0.05**	.05	.05
Per quire	**$1.00**	1.00	1.00

95W. Fire extinguisher, Pyrene. Quart size, 14 inches long, 3 inches diameter. For hanging up on the wall of laboratory. Ready for instant use **$11.50**

First Aid Cabinet is listed in Chemical Apparatus Section.

Fish Line is listed in this section under Cord.

100W. Foil, Aluminum. For repairing electroscopes, etc. In books of 25 leaves, 5x5 inches **$0.25**

Foil Copper. Listed in Raw Materials Section.

105W. Foil, Dutch Metal. Imitation gold leaf. For repairing electroscopes, etc. In books of 25 leaves, 4x4 inches **$0.50**

110W. Foil, Gold. Pure gold leaf for repairing electroscopes, etc. In books of 25 leaves, 4x4 inches. **$1.25**

Foil, Platinum. Is listed in Chemical Apparatus Section.

115W. Foil, Silver. Pure silver foil. For repairing electroscopes, etc. In books of 25 leaves, 4x4 inches **$0.35**

120W. Foil, Tin. For repairing Leyden jars, static machines, etc. Thickness .0005 inch. About 50 square feet to the pound. **Per square foot** **$0.20**

125W. Foil, Tin. Per pound **$2.25**

130W. Globe, Wire Stand, Six-inch. For geography classes or individual students' use. Maps constantly kept up to date, showing all the latest changes.. **$0.90**

135W. Globes, Terrestrial. Plain stand.

Diameter, inches	8	12	18
Each	**$5.50**	9.50	32.00

140W. Globes, Terrestrial. Movable meridian, graduated on both sides and easily turns to any position. Securely held by safety screws.

Diameter, inches	8	12	18
Each	**$8.00**	12.50	36.00

145W. Globes, Terrestrial. Full mounted movable meridian graduated on both sides, time horizon, and safety set-screw.

Diameter, inches	8	12	18
Each	**$10.00**	15.50	42.50

150W. Glue, LePage's. Per ounce bottle **$0.30**

155W. Glue, LePage's. Per 4 ounce can ..... **.40**

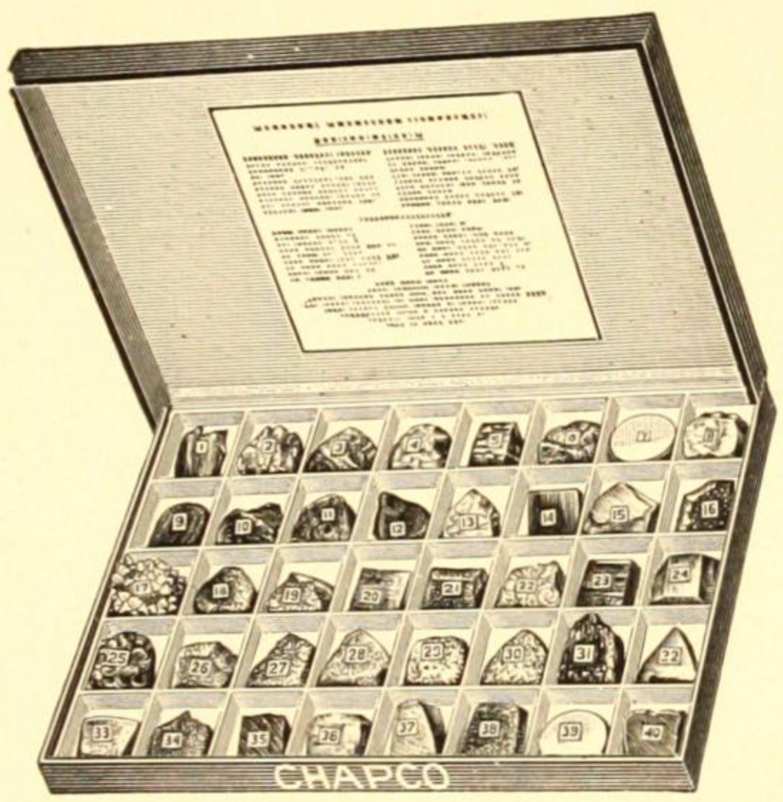
160W. Glue, Marine, Waterproof. Per ounce bottle **$0.30**



No. 165W.



No. 179W.



No. 185W.

165W. **Grease, Stopcock.** Dr. Ernest's special. Made according to formula of Dr. T. R. Ernest, Prof. Chemistry, Crane Junior College, Chicago. A rubber base grease, practically neutral in reaction and of a viscosity such that it produces a perfect seal even under vacuum on stopcocks, bell jars, desiccators, etc. It will not harden, or dry out, but remains soft and useful at all times. It is non-volatile and therefore suitable for use in high vacuum work. For lubricating the stopcocks of delicate glass apparatus it has no equal. It absolutely prevents sticking, which frequently causes breakage in apparatus of this kind. **Per tube** **$0.35**

170W. **Lacquer, Colorless.** For covering polished brass, copper and other metal surfaces.
Per ounce bottle **$0.25**

175W. **Lacquer, Gold.** For covering polished brass surface. **Per ounce bottle** **$0.40**

179W. **Library Paste, Grip-fix.** A clean white adhesive packed in an aluminum-jar that cannot break, and with a brush enclosed. Far more economical than ordinary paste as no water is used in its composition and it cannot dry out. It will not wrinkle nor discolor and a very thin film forms a clean quick adhesion of exceptional strength.
3 oz jar **$0.35**
5 oz. jar ..... **.60**

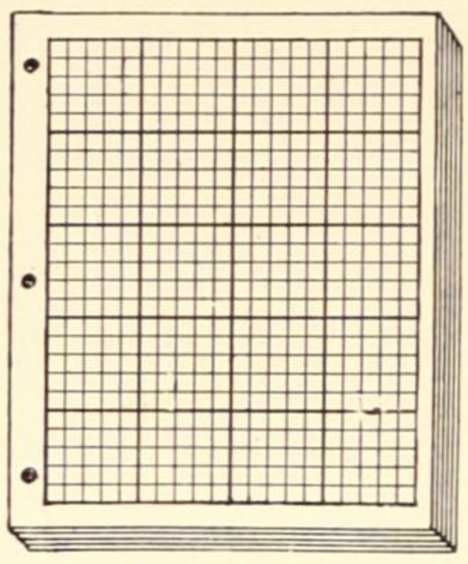
180W. **Library Paste, Sanford's.** Per 3 ounce screw cap jar **$0.20**

Matches, Safety, are listed in Chemical Apparatus Section.

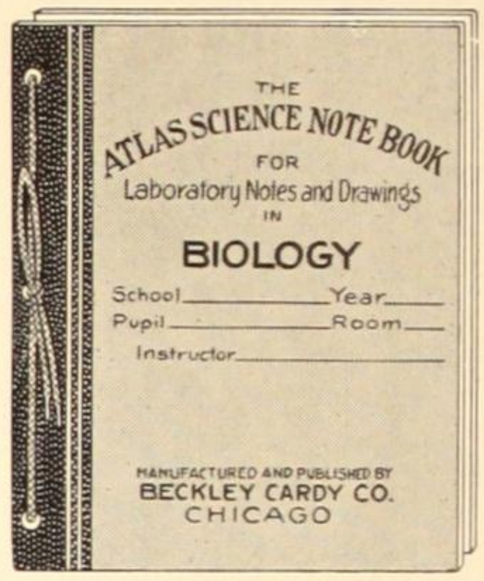
185W. **Minerals, Washington School Collection.** Contains 20 minerals and 20 rocks. Good sized specimens, each labeled and placed in a separate tray. In neat cloth-covered case with a set of unlabeled duplicates **$5.50**

190W. **Minerals, Washington School Collection.** Student's small specimens unlabeled, 20 rocks, 20 minerals **$0.50**

NOTE BOOKS, ATLAS SERIES



No. 390W.



No. 410W.

Accepted generally by instructors as the Standard Series for all School Subjects. Tablets are all uniform in size, 7¾x9¾ inches, and perforated.

COVERS ONLY, WITHOUT FILLERS

Lace Fastener Covers, two piece, board sides, cloth hinges with metal eyelets. Covers only (without fillers), any subject. Weight, 8 oz. **Per set**....**$0.18**

Cat. No.	Subject	Cat. No.	Subject
330W.	Agriculture	355W.	Mathematics
335W.	Biology	360W.	Physics
340W.	Botany	365W.	Physiology
345W.	Chemistry	370W.	Plain (without subject)
350W.	General Science	375W.	Zoology

Fillers Only, Without Covers

380W. Drawing Paper Tablet. Containing 28 sheets extra quality white drawing paper, with perforations and marginal rulings. **Per tablet**.....**$0.18**

385W. Ledger Drawing Tablet. Containing 28 sheets high grade, smooth paper for pen and ink drawings, with perforations and marginal rulings. **Per tablet** **$0.18**

390W. Metrically Ruled Tablet (Cross Section Paper). Containing 38 sheets of metrically ruled paper, with heavy lines enclosing a square centimeter, and light lines a 2 millimeter square. With note ruling and marginal line on opposite side; perforated. **Per tablet** **$0.22**

395W. Ruled Note Tablet. Containing 28 sheets extra quality ruled paper with marginal ruling, perforated to fit covers. **Per tablet**.....**$0.15**

400W. Unruled Note Tablet. Containing 28 sheets of extra quality unruled paper, perforated to fit covers. **Per tablet** **$0.15**

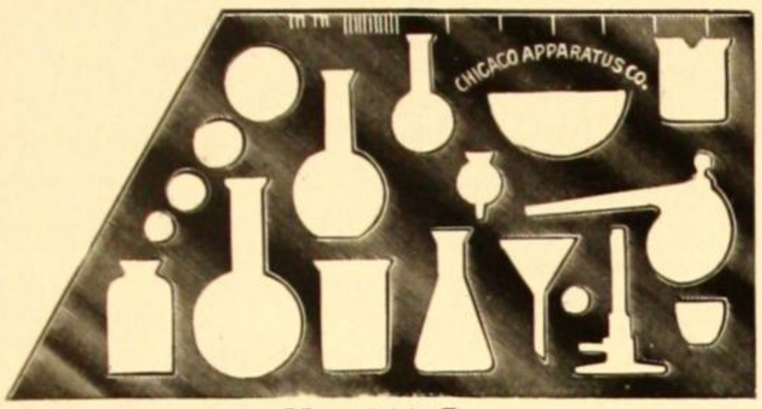
Note Books, Complete

Including one tablet 28 sheets heavy ruled writing paper (No. 395W), one tablet 28 sheets heavy white drawing paper (No. 380W), and one set covers with lace fasteners **$0.50**

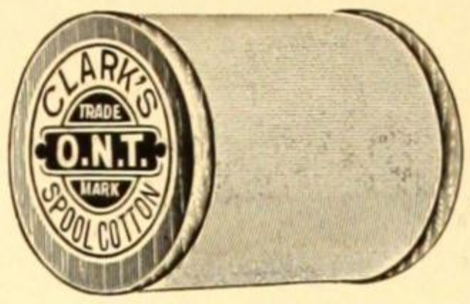
Cat. No.	Subject	Cat. No.	Subject
405W.	Agriculture	425W.	Physiology
410W.	Biology	430W.	Plain (without subject)
415W.	Botany		
420W.	General Science	435W.	Zoology

Including one tablet 38 sheets metrically ruled paper (No. 390W), and one set covers with lace fasteners **$0.40**

Cat. No.	Subject	Cat. No.	Subject
440W.	Chemistry	450W.	Physics
445W.	Mathematics		



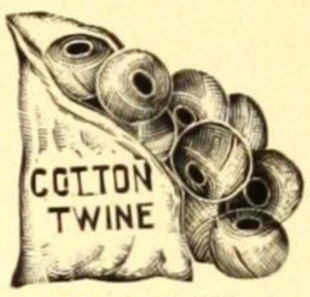
No. 1550C.



No. 620W.



No. 633W.



No. 650W.

Paper, Blue Print, is listed in Physical Apparatus—Magnetism Section.

Paper, Emery, is listed in this section under Emery Paper.

500W. **Paper, Paraffin.** In sheets 12x18 inches.
Per quire **$0.30**

Paper, Parchment, is listed in Physical Apparatus—Mechanics of Gases Section.

Paste is listed in this section under Library Paste.

505W. **Pencil Sharpener. Chicago.** For standard size pencils, removable celluloid shavings box..... **$1.00**

510W. **Pins.** Ordinary bankers' pins in ½ lb. boxes.
Per box **$0.75**

842R. **Rope, Manila.** Three-eighths inch diameter, good grade, for use with large pulleys such as our No. 841R, etc. (Orders cannot be filled for less than 12 feet). **Per foot** **$0.05**

535W. **Rubber Bands.** Assorted, in ¼ lb. boxes.
Per box **$0.60**

555W. **Sand Paper.** In sheets 9x11 inches.

Abrasive No.	00	0	1	2
Per sheet	**$0.07**	.07	.07	.07
Per quire	**$0.50**	.50	.50	.50

Sealing Wax is listed in this section under Wax.

565W. **Sewing Needles.** Package of 25.
Per package **$0.11**

Splints are listed in the Chemical Apparatus Section.

1535C. **Sponges.** Selected quality, very soft for cleaning glassware, porcelainware, etc. **Each**..... **$0.20**

1550C. **Stencil, Chemistry.** A flexible transparent plate with "cut-outs" representing outlines of various chemical utensils. The ruling edges of the obtuse angle serve as convenient guides in drawing delivery tubes. One edge has a metric scale for dimensions. Recommended by prominent teachers of chemistry because its use eliminates bad drawings, saves time, inspires the pupils, holds their attention and induces accurate thinking. Size, about 7.5x14.5 cm. **$0.15**

615W. **Tape, Friction.** Black insulating tape, ¾ inch wide, best sticking qualities, in 4 ounce (30 ft.) rolls, in neat carton. **Per roll**..... **$0.25**

620W. **Thread, Cotton.** White, No. 70, in spools of 150 yds. **Per spool**..... **$0.12**

625W. **Thread, Linen.** Black, No. 30, in spools of 200 yds. **Per spool** **$0.55**

630W. **Thread, Silk.** Black, No. A, in spools of 50 yds. **Per spool** **$0.16**

632W. **Toweling, Crash.** Standard quality, about 17 inches wide. **Per yard** ..... **$ 0.30**
Per 50 yard bolt **12.50**

633W. **Tumbler.** Heavy glass, 73 mm. inside diameter at top, 90 mm. high..... **$0.10**

634W. **Tumbler, Glass.** So-called Jelly Tumbler, with tin cover. **Per dozen**..... **$0.75**

650W. **Twine, Cotton.** 3-ply white wrapping twine.
Per ball **$0.20**

655W. **Twine, Linen No. 9.** White, extra strong.
Per ball **$0.50**

665W. **Wax, Bees'.** Genuine, unbleached.
Per lb. **$1.00**

670W. **Wax, Bees'.** Imitation, so-called ceresin, yellow. **Per lb.** **$0.75**

185F. **Wax, Sealing.** Red express wax, 4 sticks to the pound. **Per lb.** **$0.80**

675W. **Wax Tapers.** 17 inches long.
Per box of 30 ..... **$0.20**

Raw Material and Wire

We have listed the following materials bearing in mind the special purposes for which these items will be used in the laboratory and laboratory shops and have governed our sizes and specifications accordingly. No quantities smaller than those listed will be sold.

RAW MATERIAL

Wire of all kinds is listed on pages succeeding raw materials.

Aluminum

5D. Aluminum Rod. In 3 foot lengths.

Diameter, inches	¼	½	¾	1
Per length	$0.30	1.00	2.00	3.00

10D. Aluminum Sheet. In square foot pieces.

B. & S. gauge No.	20	30
Thickness, inches	.032	.010
Per piece	$0.50	.35

Asbestos

15D. Asbestos Cement. Retort cement. Acid and fire proof. Used with electric furnaces, retorts, etc. In cans.

Weight, lbs.	1	5
Each	$0.35	.95

20D. Asbestos Cord or Twine. In ¼ lb. balls

Diameter of cord in inches	1/16	⅛
Per ball	$0.75	.75

Asbestos Mats, Square, 1/16 inch thick.

Cat. No.	51C	52C
Size, inches	5x5	6x6
Dozen	$0.40	.50

45C. Asbestos Pad, on Plate. Round, tin bound edge, with ring for suspension. Diameter, 8½ inches.
Each $0.12

30D. Asbestos Paper. Thickness about .028 inch. In square yard pieces. **Per square yard** $0.30

35D. Asbestos Sheet. In sheets 42x48 inches and in square pieces 12x12 inches.

Thickness, inches	1/32	1/16	⅛	¼
Per piece (12x12 inches)	$0.15	.20	.50	.90
Per sheet (42x48 inches)	.65	1.00	3.00	5.25

40D. Asbestos Slate. Transite, fire and acid proof. A non-conductor of electricity that finds many uses in the laboratory as a heat or electrical insulator. Protects table tops from effects of heat or acid. Used extensively in laboratory shops in making apparatus. Can be cut or sawed the same as wood. In pieces 42x48 inches.

Thickness, inches	⅛	3/16	¼	½
Per sheet	$4.40	6.00	7.80	13.50

45D. Asbestos Slate, Square. Better than asbestos pad; piece 12x12x⅛ inches.
Per square $0.50

Brass

50D. Brass Rod, Round. In 3 foot lengths.

Diameter, inches	⅛	¼	⅜	½
Per length	$0.15	.35	.75	1.25

55D. Brass Rod, Square. In 3 foot lengths, size ¼x¼ inch $0.50

60D. Brass Sheet. In square foot pieces.

B. & S. gauge No.	20	30
Thickness, inches	.032	.010
Per piece	$0.90	.45

65D. Brass Strip. In 3 foot lengths.

Size, inches	1/16x½	⅛x½
Per piece	$0.35	.60

70D. Brass Tubing. In 3 foot lengths. Thickness of wall is No. 18. B. & S. gauge (.040 inch).

Diameter, outside, inches	¼	⅜	¾	1
Per length	$0.45	.50	.90	1.25

Carbon

Carbons for all lamps are listed in Physical Apparatus—Light Section.

Carbons for batteries are listed in Physical Apparatus—Electricity Section.

75D. Carbon, Granulated. For experimental purposes. **Per pound** $0.40

80D. Carbon, Rod. Plain, 12 inches long.

Diameter, inches	⅛	3/16	¼	⅜	½
Each	$0.18	.18	.18	.18	.25

85D. Carbon, Sheet. In square foot pieces. ¼ inch thick. **Per piece** $3.00

Copper

90D. Copper, Rod. In 3 foot lengths.

Diameter, inches	¼	½
Per length	$0.45	1.50

95D. Copper, Sheet. In square foot pieces.

B. & S. gauge No.	20	24	28	30
Per piece	$1.20	.90	.70	.65

100D. Copper, Sheet, Foil. Thin sheet No. 36 B. & S. gauge (.005 inch), in pieces 8x12 inches.
Per piece $0.35

102D. Copper, Wire Gauze. In square foot pieces.

Mesh	60	80	100
Per piece	$1.15	1.40	1.60

Note: Full length of rods and tubing can usually be supplied in pieces 10 to 12 feet in length. To facilitate shipping they are cut in lengths as quoted above. On special request they will be shipped full length.

Raw Materials—Cont.

Fiber

105D. **Fiber, Rod, Black.** In lengths of about 30 inches.

Diameter, inches	3/8	3/4
Per length	**$1.25**	**3.50**

110D. **Fiber, Sheet, Black.** In square foot pieces.

Thickness, inches	1/8	1/4
Per piece	**$1.00**	**2.00**

115D. **Fiber Tubing, Black.** Thickness of wall 1/16 inch. In pieces about 30 inches long.

Diameter, inside, inches	1/4	3/8
Per length	**$0.80**	**1.00**

Foils of all kinds are listed in "W" section.

Iron

Filings are listed under Physical Apparatus—Magnetism Section.

120D. **Iron, Rod, Soft.** Genuine Norway Iron as used in electromagnets. In 3 foot pieces.

Diameter, inches	1/4	3/8
Per piece	**$0.25**	**.45**

125D. **Iron, Sheet.** In square foot pieces.

Thickness, inches	1/64	1/32	1/16
Per piece	**$0.25**	**.35**	**.50**

Lead

130D. **Lead, Sheet.** In square foot pieces.

Thickness, inches	1/64	1/32	1/16
Per piece	**$0.70**	**.90**	**1.50**

Lead Shot is listed under Physical Apparatus—Heat Section.

Mica

135D. **Mica, Sheet.** Best quality for insulating purposes.

Size, inches	2x4½	4x5	4x6	5x7
Per sheet	**$0.10**	**.20**	**.30**	**.50**

Nickel

140D. **Nickel, Sheet.** Pure grade for chemical work. In square foot pieces. B. & S. gauge No. 22 (.025 inch). **Per piece** **$3.50**

Rubber

145D. **Rubber Cement.** For connecting and patching rubber goods. **Per oz. bottle** **$0.25**

150D. **Rubber, Rod, Hard.** Black polished, 30-inch lengths. Best quality for insulating purposes and for making friction rods.

Diameter, inches	3/8	3/4
Per length	**$0.60**	**2.00**

Rubber, Sheet or Dam, soft, is listed under Physical Apparatus—Mechanics of Gases Section.

155D. **Rubber, Sheet, Hard.** Black polished in square foot pieces.

Thickness, inches	1/16	1/4
Per piece	**$1.65**	**4.00**

Rubber Tubing, soft, all kinds, is listed in Chemical Apparatus Section.

Steel

160D. **Steel, Rod, Coppered Bessemer.** Round, in 4-foot pieces.

Diameter, inches	3/8	1/2
Per length	**$0.30**	**.45**

165D. **Steel, Rod, Plain, Cold Rolled.** Round, in 3-foot pieces.

Diameter, inches	1/4	3/8	1/2
Per length	**$0.15**	**.25**	**.35**

170D. **Steel, Rod, Magnet.** Round, in 3-foot pieces.

Diameter, inches	1/4	3/8	1/2	3/4
Per piece	**$0.75**	**1.35**	**2.25**	**4.80**

175D. **Steel, Rod, Magnet.** Square, in 3-foot pieces.

Size, inches	1/4	3/8	1/2	3/4
Per piece	**$0.90**	**1.80**	**3.00**	**6.00**

Tin

180D. **Tin, Sheet.** Pure block tin, No. 22 B. & S. gauge (.025 inch), in square foot pieces.
Per piece **$2.00**

185D. **Tin Tubing.** Pure block tin.

Diameter, inside, inches	3/16	1/4
Per foot piece	**$0.60**	**.70**

Zinc

190D. **Zinc, Sheet.** In square foot pieces.

Thickness, inches	1/64	1/32	1/16
Per piece	**$0.35**	**.50**	**.90**

Note: Full lengths of rods and tubing can usually be supplied in pieces 10 to 12 feet in length. To facilitate shipping they are cut in lengths as quoted above. On special request they will be shipped full length.



Nos. 210D-240D.

Wire of All Kinds

Prices include spools.
No quantities smaller than those priced will be sold.

Wire Gauge Tables

B. & S. gauge, Nos. ..	14	16	18	20	22	24	26	27	28	30	32	34	36	40
Approx. diam., in.	.064	.051	.040	.032	.025	.020	.016	.014	.013	.010	.008	.006	.005	.003
W. & M. gauge, Nos.						16	18	20	22	24	26	27	28	30
Approx. diam., inches						.063	.047	.035	.028	.023	.018	.017	.016	.014
Music gauge, Nos.						00	0	1	2	3	4	5	6	7
Approx. diam., inches						.008	.009	.010	.011	.012	.013	.014	.016	.018
Music gauge, Nos.						8	9	10	12	14	18	23	26	
Approx. diam., inches						.020	.022	.024	.029	.033	.041	.051	.063	

200D. Wire, Aluminum, Soft. 99% pure. In spools of 200 feet.

Sizes, B. & S. gauge.....	16	18	20	24	26	28	30
Diameter, inches	.051	.040	.032	.020	.016	.013	.010
Per spool	**$1.65**	**1.50**	**1.25**	**1.15**	**1.00**	**.95**	**.90**

210D. Wire, Brass, Bare. Spring temper, on 4-ounce spools.

Sizes, W. & M. gauge.....	16	18	20	22	24	26	27	28	30	32	34	36
Diameter, inches	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Feet, per spool	13	33	47	76	108	192	207	237	315	378	573	765
Per spool	**$0.25**	**.25**	**.25**	**.30**	**.35**	**.35**	**.40**	**.40**	**.45**	**.50**	**.65**	**1.00**

220D. Wire, Chrome-Silicon-Steel, Bare. An alloy wire that will resist oxidation and corrosion much better than nickel-chrome alloys. Suffers no deterioration from high temperatures (2000° F—1100° C) and is non-corrosive. Especially suited for constructing resistance coils and heating devices. Resistance is 65 times that of copper. Temperature coefficient for 1° C = .000127. Melting point 2750° F or 1510° C.

B. & S. Gauge.....	20	22	24	28	30	32	38	40
Diameter, inches	.032	.025	.020	.013	.010	.008	.004	.003
Ohms per 1000 feet 770° F.....	638	1019	1616	4112	6530	10200	40810	68000
Feet per pound.....	381	609	965	2456	3900	6090	24380	40590
Per 4 oz. spool.....	**$1.75**	**2.00**	**2.25**	**2.75**	....	....	....	....
Per 1 oz. spool.....	....	....	....	....	**1.50**	**1.75**	**4.25**	**5.50**

225D. Wire, Chromel (Nichrome), used in making resistance and heating coils. This is an alloy wire composed of nickel and chromium; it has a melting point of 1385° C and a resistance approximating ten times the resistance of platinum. In 4 oz. spools.

B. & S. No.....	20	22	24	28	30	32	38	40
Per spool	**$1.75**	**2.00**	**2.25**	**3.00**	**3.50**	**3.75**	**7.50**	**12.00**

230D. Wire, Copper, Annunciator. For call bells, annunciator wiring, etc. Double cotton covered and paraffined. Sold in 1-lb. coils only.

Size, B. & S. gauge.....	16	18	20	22	24
Approx. feet per pound.....	105	165	230	350	550
Per pound coil	**$0.65**	**.75**	**.90**	**1.00**	**1.25**

240D. Wire, Copper, Bare. Soft temper on 4 ounce spools.

Sizes W. & M. gauge.....	16	18	20	22	24	26	27	28	30	32	34	36
Diameter, inches	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Feet per spool.....	13	32	47	76	108	192	207	237	315	378	573	765
Per spool	**$0.25**	**.25**	**.25**	**.30**	**.30**	**.30**	**.35**	**.40**	**.45**	**.50**	**.75**	**1.00**

250D. Wire, Copper, Double Cotton Covered. (D. C. C. Magnet Wire.)

Sizes B. & S. gauge.....	16	18	20	22	24	26	27	28	30	32	34	36	40
Diameter, inches	.051	.040	.032	.025	.020	.016	.014	.013	.010	.008	.006	.005	.003
Per 4 oz. spool.....	**$0.36**	**.40**	**.40**	**.45**	**.50**	**.65**	**.75**	**.75**	**.85**	**1.00**	**1.50**	**1.90**	**3.10**
Per lb. spool.....	**1.10**	**1.15**	**1.20**	**1.30**	**1.60**	**2.00**	**2.40**	**2.60**	**3.15**	....	....	....	....

255D. Wire, Copper, Double Silk Covered. (D. S. C. Magnet Wire.)

Size B. & S. gauge.....	16	18	20	22	24	26	27	28	30	32	34	36	40
Per 4 oz. spool.....	**$0.45**	**.50**	**.55**	**.60**	**.80**	**.85**	**.95**	**1.00**	**1.30**	**1.70**	**2.10**	**2.50**	**3.00**

260D. Wire, Copper, Enameled. In 4 ounce and 1 lb. spools.

B. & S. gauge No.....	26	28	30	36	40
Diameter, inches	.016	.013	.010	.005	.003
Feet per 4 oz. spool.....	320	512	800	3200	8000
Per 4 oz. spool.....	**$0.35**	**.40**	**.45**	**.75**	**1.25**
Per 1 lb. spool	**1.00**	**1.10**	**1.25**	**1.75**	**3.00**

Prices include spools.
No quantities smaller than those priced will be sold.



No. 270D.

270D. Wire, Copper, Lamp Cord. Green-Yellow twisted pair lamp cord—the cord in most general use for pendant switches and drop lights. (Orders cannot be filled for less than 12 feet.)

B. & S. gauge No.	16	18
Per foot	**$0.05**	**.05**

280D. Wire, Copper, Rubber Covered. (Orders cannot be filled for less than 12 feet.)

B. & S. gauge No.	12	14
Diameter, inches (less insulation)	.081	.064
Per foot	**$0.05**	**.05**

290D. Wire, Fuse.

Amperes	½	1	2	3	5	6	10	15	40
Size of spools	4 oz.	8 oz.	8 oz.	8 oz.	1 lb.	1 lb.	1 lb.	1 lb.	1 lb.
Feet per spool	500	400	340	220	168	145	82	53	17
Per spool	**$2.00**	**2.00**	**1.60**	**1.40**	**2.00**	**2.00**	**1.75**	**1.75**	**1.50**
Per 25 feet	**.25**	**.25**	**.30**	**.35**	...	...	...	...	...
Per 10 feet	...	...	...	...	**.20**	**.25**	**.30**	**.45**	...

300D. Wire, German Silver, Bare. 18% nickel spring temper. (Nickel-Silver Wire.)

Sizes B. & S. gauge	16	18	20	22	24	26	27	28	30	32	34	36
Diameter, inches	.051	.040	.032	.025	.020	.016	.014	.013	.010	.008	.006	.005
Feet per 4 oz. spool	33	52	83	132	210	334	421	531	844	1342	2133	3392
Per spool (4 oz.)	**$0.45**	**.50**	**.55**	**.65**	**.70**	**.75**	**.80**	**.80**	**1.00**	**1.10**	**1.35**	**1.50**
Per spool (1 oz.)	...	...	...	...	**.30**	**.35**	**.35**	**.35**	**.40**	**.50**	**.55**	**.60**

310D. Wire, German Silver, Double Cotton Covered. 18% nickel. (Nickel-Silver Wire.)

Size B. & S. gauge	16	18	20	22	24	26	28	30	32	34	36
Per spool (4 oz.)	**$0.75**	**.80**	**.90**	**1.00**	**1.25**	**1.45**	**1.75**	**2.00**	**2.25**	**2.80**	**3.25**
Per spool (1 oz.)	...	...	...	...	**.35**	**.45**	**.50**	**.60**	**.65**	**.75**	**.90**

320D. Wire, Lead. Diameter ⅛ inch. (Orders cannot be filled for less than 6 feet) ..... **Per foot $0.05**

325D. Wire, Manganin, Resistance. Used in making the highest grade measuring instruments such as: Resistance Boxes, etc. This is an alloy wire composed of manganese, nickel and copper; it has a temperature coefficient at 1° C of .00001. Double cotton covered.

B. & S. gauge No.	18	20
Per oz.	**$1.00**	**1.05**

326D. Wire, Manganin, Resistance, same as No. 325D, but double silk covered.

B. & S. Gauge No.	22	24	26	28	30	32	34	36	38
Per oz.	**$1.00**	**1.10**	**1.25**	**1.35**	**1.50**	**1.75**	**2.00**	**2.60**	**3.50**

Wire, Nickel Silver. See German Silver Wire listed above.

330D. Wire, Piano. Steel piano wire on small spools.

Sizes, Music gauge	00	0	1	2	3	4	5	6	7	8
Diameter, inches	.008	.009	.010	.011	.012	.013	.014	.016	.018	.020
Feet per spool	20	16	14	12	12	12	10	10	8	8
Per spool	**$0.25**	**.20**	**.20**	**.20**	**.20**	**.20**	**.20**	**.15**	**.15**	**.15**

340D. Wire, Piano. Steel, in ¼ pound rolls.

Music, gauge No.	8	9	10	12	14	18	23	26
Diameter, inches	.020	.022	.024	.028	.032	.040	.051	.063
Per roll	**$0.65**	**.65**	**.65**	**.65**	**.60**	**.60**	**.50**	**.50**

350D. Wire, Picture. Standard steel picture wire in packages of 25 yards.
No. 1 ..... **Per package $0.20**

Wire, Platinum, is listed in Chemical Apparatus Section.

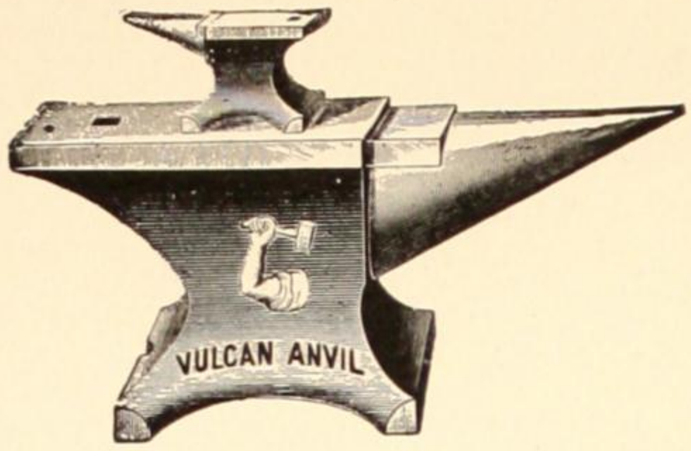
360D. Wire, Steel. Soft black annealed steel wire, on 4 ounce spools.

Sizes W. & M. gauge	16	18	20	22	24	26	27	28	30	32	34	36
Diameter, inches	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Feet per spool	24	45	78	119	180	268	300	338	463	730	1834	2860
Per spool	**$0.15**	**.15**	**.15**	**.15**	**.15**	**.15**	**.15**	**.15**	**.15**	**.20**	**.20**	**.25**

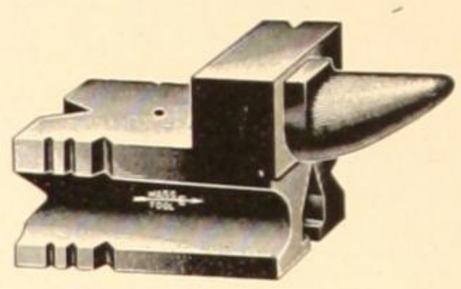
370D. Wire, Tinsel. Single conductor cordage for push buttons, annunciators, telephones, electrical apparatus, etc. Consists of 16 strands of copper tinsel twisted together and covered with an inner and outer braid of green cotton. Very flexible. Conductivity equal to No. 21 B. & S. gauge copper wire. (Orders cannot be filled for less than 6 yards) ..... **Per yd. $0.10**

380D. Wire, Zinc. Diameter, ⅛ inch. Orders cannot be filled for less than 3 feet) ..... **Per ft. .15**

TOOLS



No. 400D.



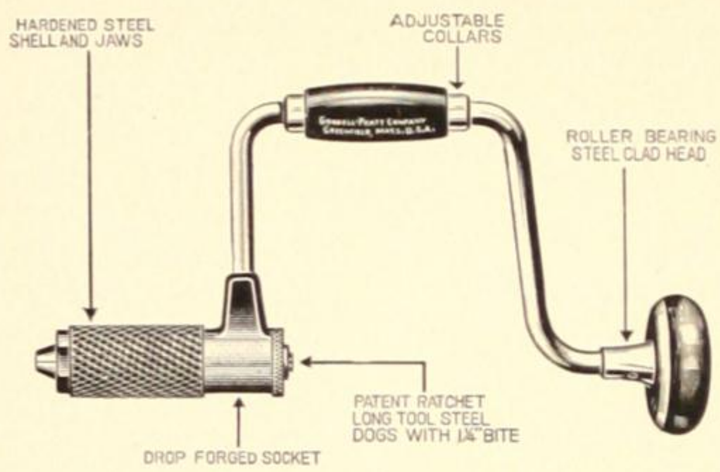
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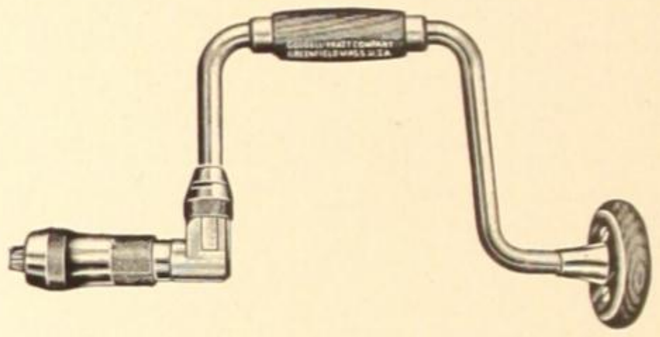
No. 415D.



No. 410D.



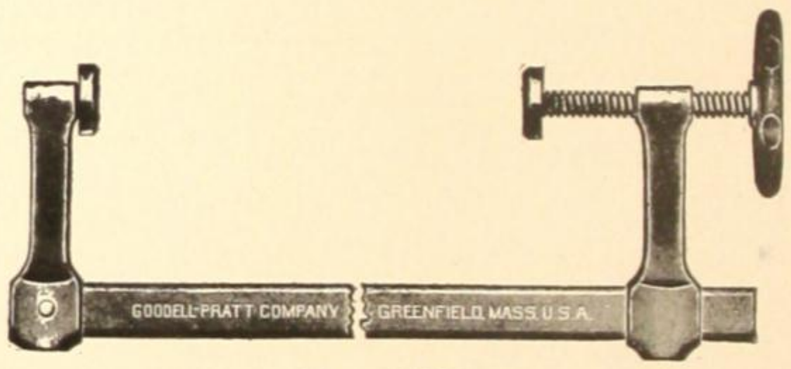
No. 430D.



No. 425D.



No. 435D.



No. 440D.

400D. Anvils. Steel Face.

Weight in pounds	15	50
Each	**$5.75**	**14.00**

405D. Anvil Bench. Goodell-Pratt. This anvil will be found very convenient and practical for use upon any tool-maker's bench; has planed and squared surfaces, milled grooves and slots; in fact, the faces of the tool are sufficiently accurate to admit of its being used as a surface plate for laying out small work. 4¾x2¼x2¼ inches **$4.40**

410D. Auger Bits. Set of thirteen, in hardwood case, ¼ to 1 inch by sixteenths of an inch..... **$8.00**

415D. Bench Table. Goodell-Pratt. A convenient table or surface plate 5 inches in diameter and adjustable from 4½ to 6½ inches high. Top turned and polished and practically true..... **$2.75**

420D. Bit Brace. Plain, polished steel shank, polished octagon pattern sleeve, ebonized hardwood head and handle, steel jaws, 8-in. sweep..... **$2.20**

425D. Bit Brace. Ratchet. Has steel-clad heads that run on roller bearings contained in dust-proof compartments. Handles run in adjustable collars. Hardwood heads and handles finished in mahogany enamel. Forged steel sweep, chuck socket, and shell of malleable iron, forged jaws, chucks hold all sizes of square shank bits. Exposed parts polished and nickeled; 8-inch sweep..... **$4.40**

430D. Bit Brace. Ratchet. Goodell-Pratt. Universal chuck holds round, square or taper shanks accurately. Large capacity; takes largest sizes of bit brace shanks. Chuck jaws and shell natural hardened steel. Ratchet is shifted by turning knurled dial on end of shank. Ratchet socket is red enameled. Steel-clad rosewood head on roller bearings; rosewood handle running on adjustable collars; highly polished nickel-plated finish on these steel parts.

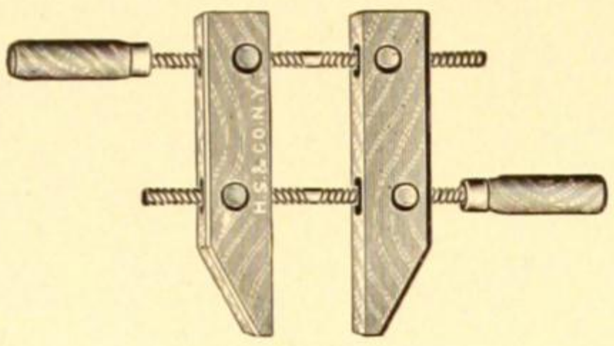
10-inch sweep	**Each $7.00**
12-inch sweep	**Each 7.20**

435D. Chisel, Cold. Length 6 inches, blade ½ inch wide, good quality **$0.25**

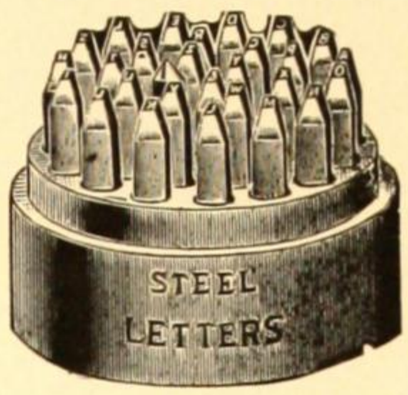
440D. Clamp, Adjustable. Goodell-Pratt. A very satisfactory clamp for light or medium work. Self-locking, quickly adjustable. Throat, 3¼ inches. Steel bar measures ⅞ in. x ¼ in. 10-inch opening... **$2.30**



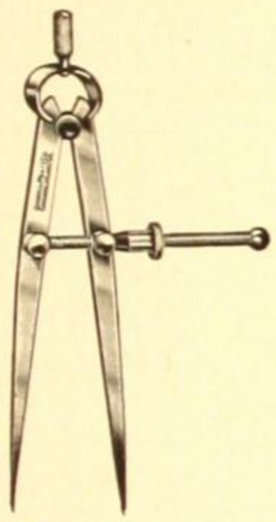
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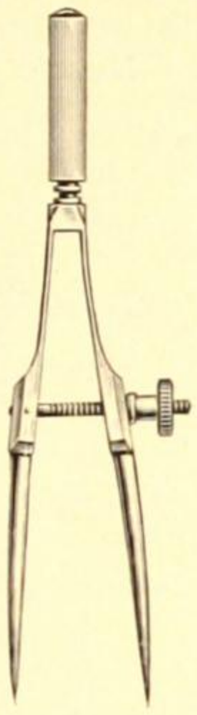
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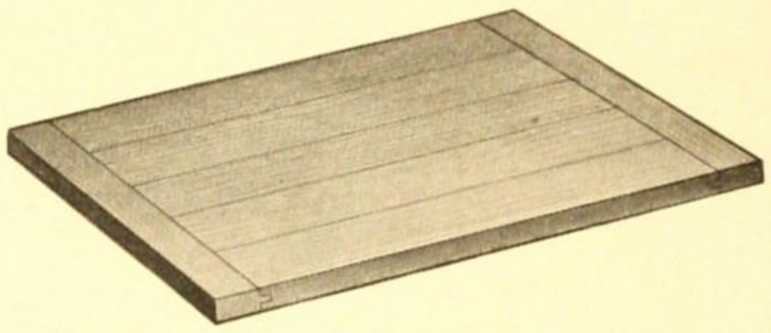
No. 475D.



No. 500D.



No. 510D.



No. 505D.

50W. Chart Graph. For full description and illustration see page 369.

445D. Clamps, Standard. Malleable iron, solid steel screw with swivel head.

Opening, inches	3	4	6
Each	**$0.45**	**.60**	**1.00**

450D. Clamps, Hand Screw. Selected maple jaws, hickory screws with saw cut threads.

Cat. No.	450D	451D
Length of jaws, inches	8	10
Opening, inches	4½	5½
Each	**$0.75**	**1.00**

460D. Cross Section Paper, Drawing. One millimeter division. Heavy line every centimeter. Printed in green ink from an engraved plate. Sheet 40x50 cm.

Per sheet **$0.25**
Per quire **4.50**

465D. Cross Section Paper, Drawing. Same as No. 460D, but in continuous roll. 50 cm. wide.

Per yard **$0.25**
Per 50-yard roll **9.00**

390W. Cross Section Paper, Tablet, for full description see page 372.

470D. Dies, Figures. Steel, from 0 to 9, for laboratory use in stamping apparatus, etc.

Face size, inches	⅛	¼
Per set	**$1.25**	**2.00**

475D. Dies, Letters. Steel, from A to Z, with period, for laboratory use in stamping apparatus, etc.

Face size, inches	⅛	¼
Per set	**$3.50**	**5.75**

288M. Divider, Plain. Brass, with sharp steel points.
Length, 11.5 cm. **$0.60**

500D. Divider Spring. Provided with solid nut. Legs are made from hard crucible steel. Every part subject to wear is hardened. Springs are stiff. Length 5 inches **$1.20**

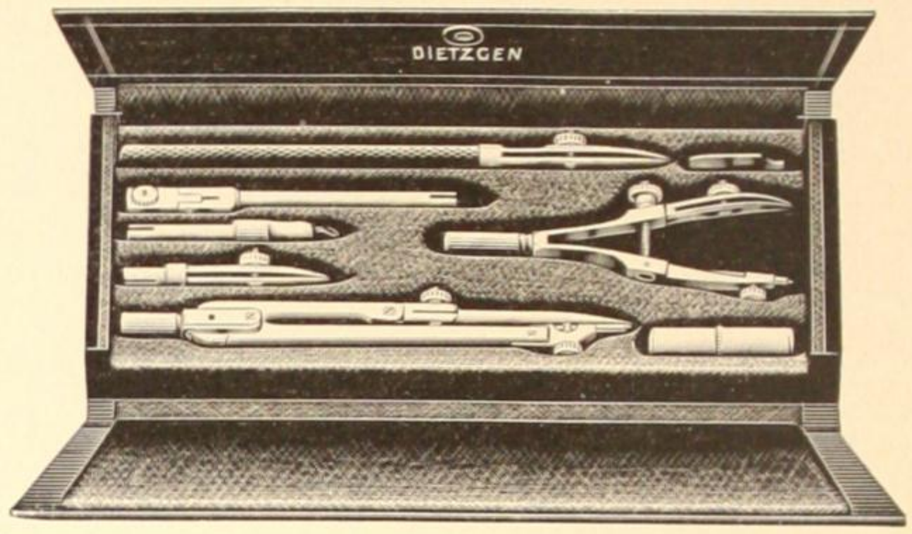
505D. Drawing Boards. Basswood, with dovetail end braces.

Size, inches	16x21	20x24
Each	**$1.25**	**1.60**

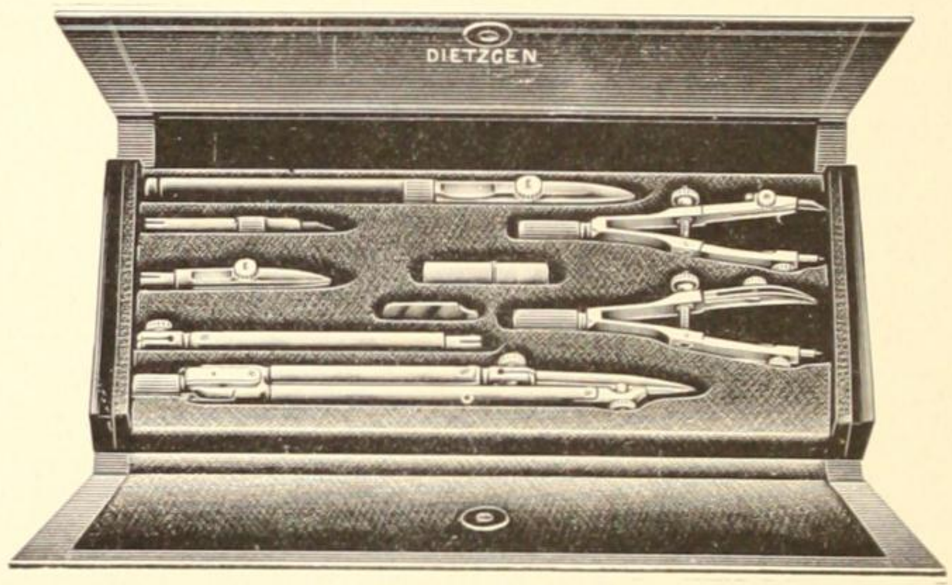
510D. Drawing Divider. Steel Spring Bow Divider, length 3¼ inches **$1.20**



No. 515D.



No. 520D.



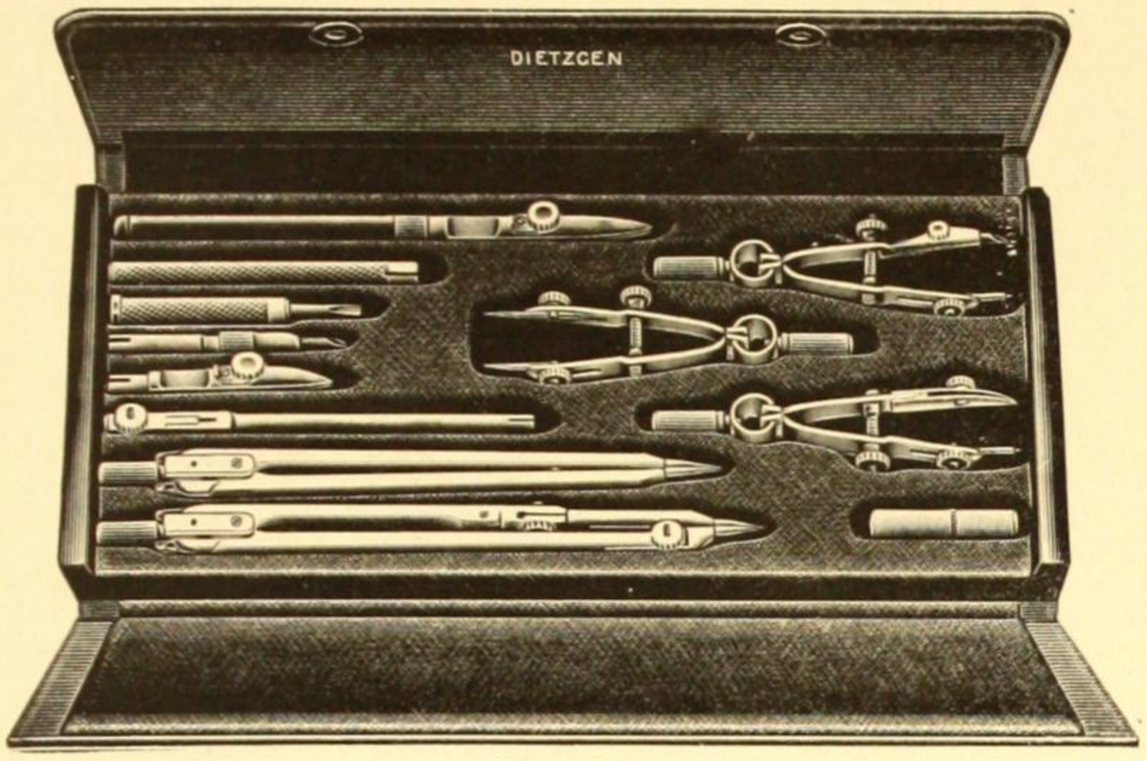
No. 525D.

515D. Drawing Ink, Higgins. In ordering be sure to specify letter designating the color desired.

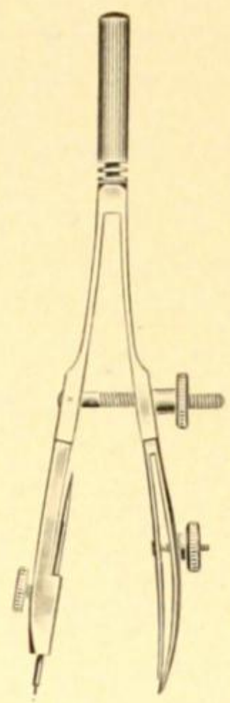
Cat. No.	A	B	C
Color	Water-proof Black	Blue	Brick Red
Per ¾-oz. bottle	$0.30	.30	.30
Cat. No.	D	E	F
Color	Brown	Carmine	Green
Per ¾-oz. bottle	$0.30	.30	.30
Cat. No.	G	H	I
Color	Orange	Scarlet	Vermillion
Per ¾-oz. bottle	$0.30	.30	.30
Cat. No.	J	K	L
Color	Violet	Yellow	White
Per ¾-oz. bottle	$0.30	.30	.30

520D. Drawing Instruments. Elementary. Pocket case containing Ruling Pen, 5-inch metal handle. Combination Bow, 3½ inches, reversible pen and pencil part. Compasses, 4¾ inches, fixed needle point leg, replaceable needle point, divider part, pen part, pencil part, lengthening bar, with key and lead box ..... **Per set $2.50**

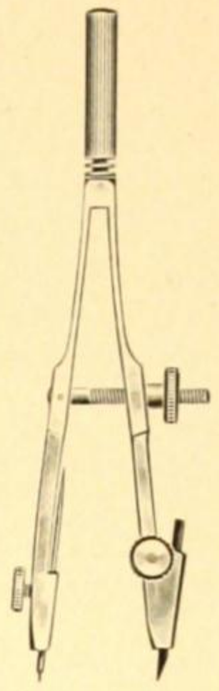
525D. Drawing Instruments. Pocket case lined with velvet, containing Ruling Pen, 5½ inches, spring blade, ebony handle. Bow Pencil, 3½ inches, side wheel. Bow Pen, 3½ inches, side wheel. Plain Dividers, 6 inches, replaceable needle points, straightening device. Compasses, 6 inches, fixed needle point leg, replaceable needle point, divider part, pencil part, lengthening bar, straightening device, with key and lead box..... **Per set $4.00**



No. 530D.



No. 535D.



No. 545D.



No. 540D.

530D. Drawing Instruments. In silk velvet lined pocket case, containing Ruling Pen, 5⅝ inches, slide-catch spring blade, ebony handle. Bow Dividers, 3½ inches, side wheel, circular head. Bow Pencil, 3½ inches, side wheel circular head. Bow Pen, 3½ inches, side wheel circular head. Plain Dividers, 6 inches, replaceable needle points, straightening device. Compasses, 6 inches, fixed needle point leg, divider part, replacement needle points, slide-catch pen part, pencil part, lengthening bar, straightening device. Combination key and lead box, box with extra needle points, metal handle for divider, pen and pencil parts. This set as listed above is of excellent quality; the instruments are of nickel silver, the needle points of steel. Their construction is such that this set is suitable for engineering and technical school work ..... **Per set $8.00**

535D. Drawing Pen. Bow, steel spring, length 3½ inches **$1.50**

540D. Drawing Pen. Ruling, spring blade, ebony handle, length 5⅝ inches **$0.50**

545D. Drawing Pencil. Bow, steel spring, length 3½ inches **$1.35**

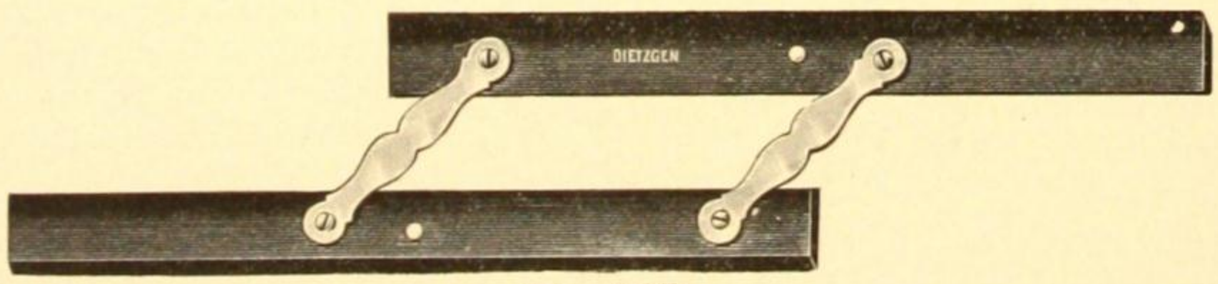
550D. Drawing Pencils. Faber. Van Dyke.

No.	2H	3H	4H
Each	$0.10	.10	.10
Dozen	1.00	1.00	1.00
Gross	10.00	10.00	10.00

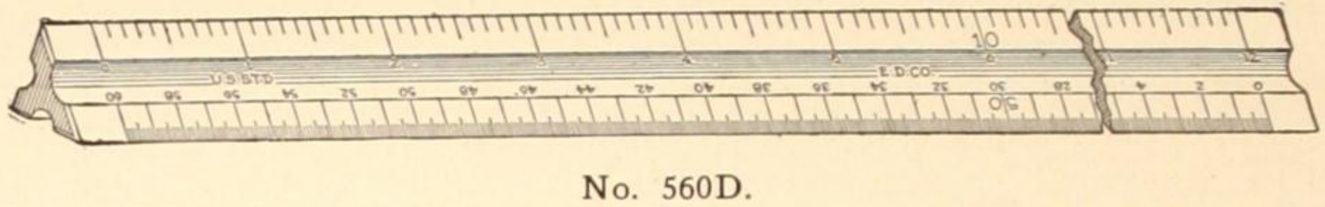
557D. Rules, Parallel. Ebony, length 12 inches. **$1.30**



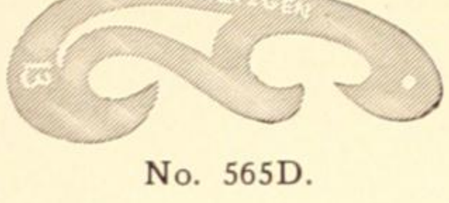
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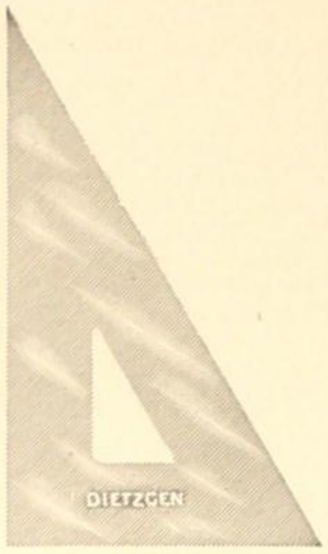
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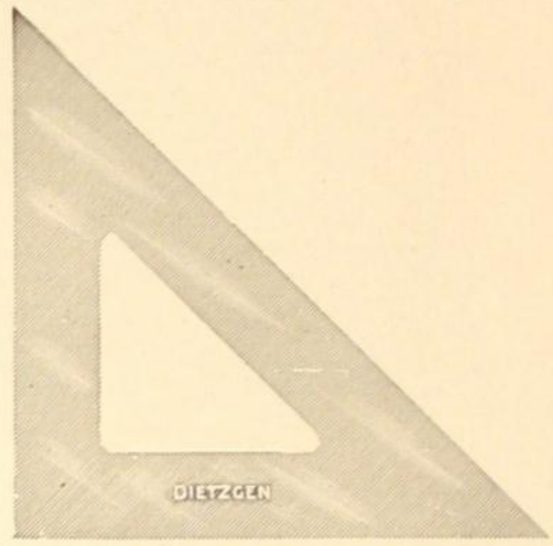
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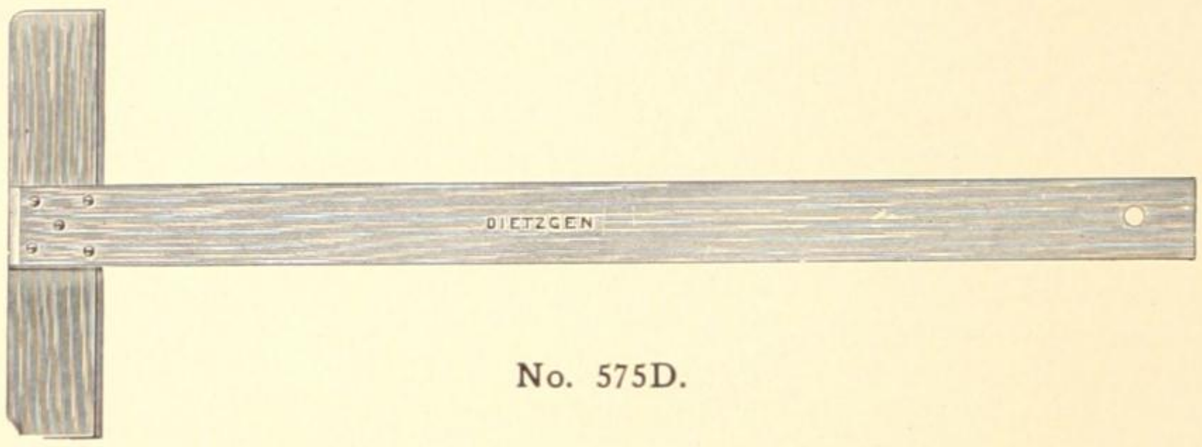
No. 565D.



(30°-60°)
No. 570D.



No. 570D (45°).



No. 575D.

560D. Scale, Triangular. Boxwood, 12-inch. One edge graduated in 1/16ths of an inch, the other edges have scales of $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, 1½, and 3 inches to the foot.....**$0.60**

565D. Curve. Transparent. Number 13.....**$0.65**

570D. Triangles. Transparent.

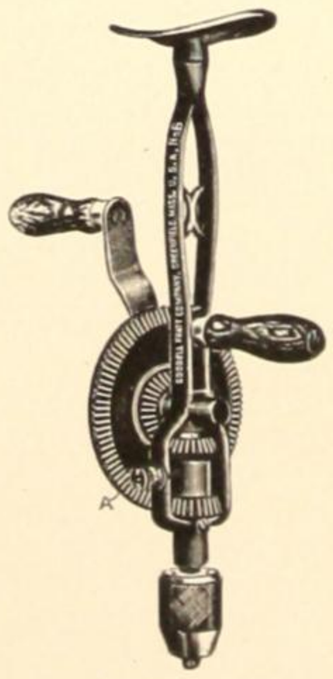
No.	1	2	3	4
Angles, degree	30 & 60	30 & 60	45	45
Size, inches	6	8	6	8
Each	**$0.30**	**.40**	**.40**	**.50**

575D. T-Squares. Maple blade and head. Finest quality made from thoroughly seasoned stock. Nicely balanced for ease in handling.

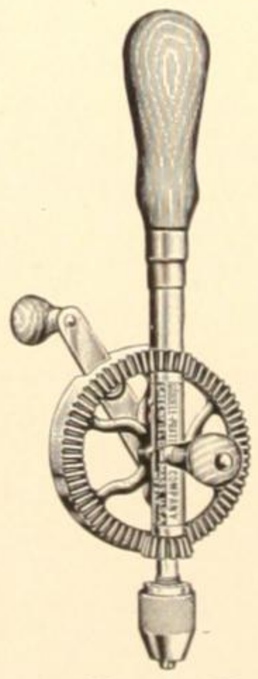
Length, inches	24	30
Each	**$0.50**	**.60**

580D. Drill, Breast. Capacity, 0 to ½ inch round shank drills. Three-jaw chuck. Two speeds, changed by turning shifter knob marked fast and slow. Adjustable enameled iron breast plate. Steel spindle has hardened end that runs in hardened steel cone bearing. Length, 16 inches.....**$6.20**

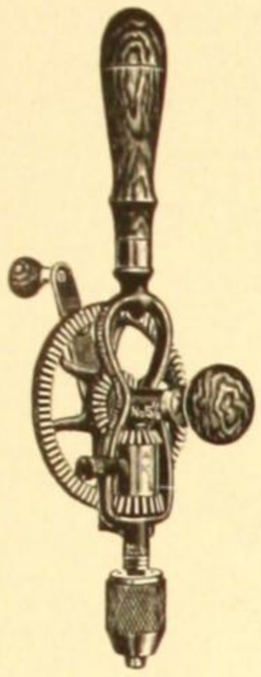
585D. Drill, Hand. Capacity, 0 to ¼ inch round shank drills. Three-jaw chuck, single speed. Has wide face, a convenience in starting drill and for delicate work. Length, 11¾ inches.....**$3.70**



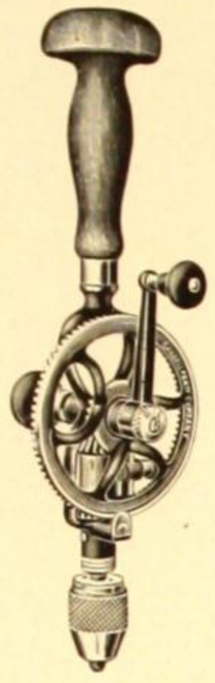
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No. 585D.



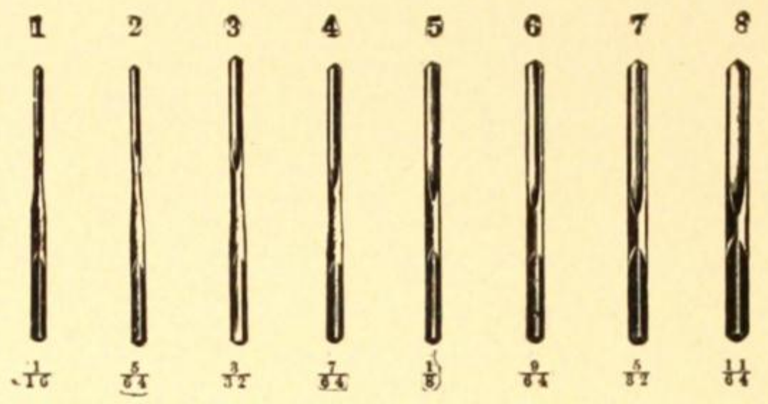
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No. 600D.



No. 610D.



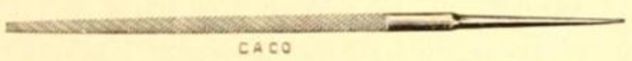
Nos. 605D-615D.



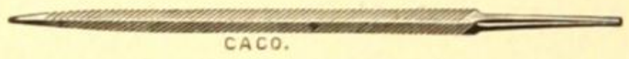
No. 630D.



No. 635D.



No. 900C.



No. 905C.



No. 640D.

590D. **Drill, Hand.** Capacity, 0 to ⅜-inch round shank drills. Three-jaw chuck. Two speeds, changed by turning the shifter knob marked fast and slow. Steel spindle runs in ball bearings; has hardened end running in cone bearing. Length, 14½ in...**$5.50**

600D. **Drill, Hand and Breast.** Capacity, 0 to ⅜-inch round shank drills. Three-jaw chucks. Two speeds, changed by turning shifter knob marked fast and slow. Accurately turned steel spindle runs in ball bearings; end runs in a hardened steel cone bearing. Right and left hand ratchet; operated by turning knurled ratchet dial. Length, 14½ inches.....**$5.50**

605D. **Drill Points.** For Nos. 580D to 600D drills. Plain round shanks. In sets of eight, 1/16 to 11/64 inch .....**Per set $0.50**

610D. **Drill, Hand, Automatic.** Magazine handle holds eight fluted drill points, 1/16 to 11/64 inch in diameter, each in a separate numbered compartment, from which they are released, one at a time, through a hole in the rotating cap. A drill point gauge shows the exact size of each drill point. Chuck has two hardened steel jaws for holding fluted shank drill points securely. All exposed metal parts are polished, nickel-plated and buffed. The tool is 10 inches long and weighs 8 ounces.....**$2.20**

615D. **Drill Points** for No. 610D Drill. Fluted shank. Eight in set from 1/16 to 11/64 in. **Per set**.....**$0.80**

620D. **Drills, Twist.** Straight round shank for wood or metal.

Diam., inches	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2
Each	**$0.10**	.12	.15	.21	.30	.40	.55	.75

625D. **Drills, Twist.** All sizes, Nos. 1 to 60 Stubs' steel wire gauge, on neat iron base.....**$9.00**

630D. **Files, Half Round.** Bastard cut. Cutting portion 10 inches.....**Each $0.45**

635D. **Files, Half Round.** Cabinet wood rasps. Cutting portion 10 inches.....**Each $0.50**

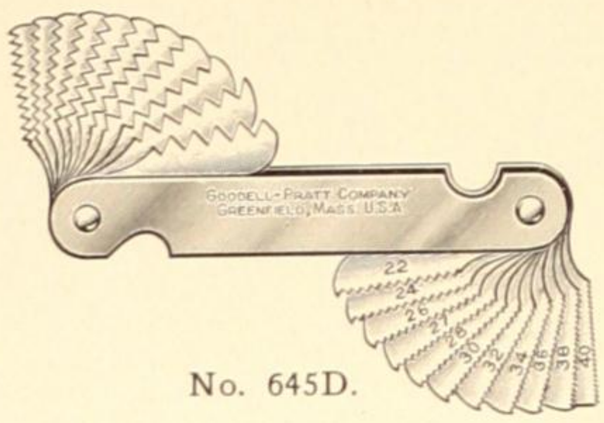
900C. **Files, Round.** (Rat tail.) Bastard cut. For perforating corks, etc.

Length, inches (of cut portion only).....	4	5	6
Each	**$0.15**	.17	.20

905C. **Files, Triangular.** Slim taper, single cut, for cutting glass tubing, etc.

Length, inches (of cut portion only)...	3	4	5	6
Each	**$0.10**	.12	.13	.19

640D. **File Handle.** Soft wood, short ferrule....**$0.08**



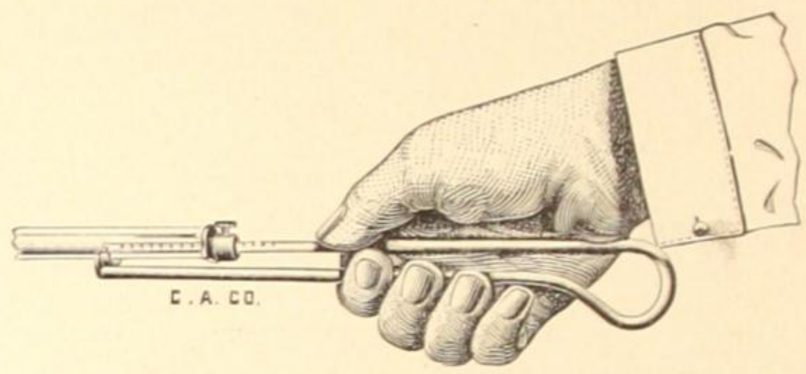
No. 645D.



No. 1130C.



No. 1135C.



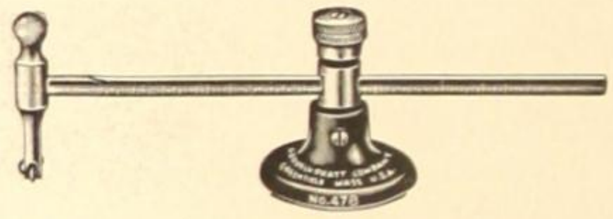
No. 1140C.



No. 660D.



No. 1155C.



No. 650D.

645D. **Gage,** Screw Pitch. With 24 pitches. 4 to 30 threads to the inch. V-thread.....**$1.65**

298M. **Gage, Tube.** Range 0 to 15 millimeters, by $\frac{1}{10}$ millimeters. For measuring the diameter of holes, the bore of glass and rubber tubing, etc. Made of metal, finely polished.....**$1.50**

303M. **Gage, Wire.** American Standard (B. & S.). Takes in numbers 5 to 36. The decimal equivalents of each number are stamped on the back. Each gage is tested after hardening and is warranted accurate. **$2.50**

304M. **Gage, Wire.** Takes in numbers 0 to 36, otherwise same as No. 303M.....**$3.00**

Illustrations of Nos. 298M-303M-304M on Page 248.

1127C. **Glass Cutter, Parker.** For cutting glass by leading a crack in the desired direction. Copper head with four sharp edges, burner tube, large wood handle. Designed to operate on coal gas. Illustrated in Chemical Apparatus Section.....**$2.00**

1130C. **Glass Cutter, Steel Wheel.** Made entirely of steel, red finished handle, hand-honed cutting wheel, length 4¾ inches.....**$0.20**

1135C. **Glass Cutter, Steel Wheel.** Nickel-plated head and ferrule, turret holder with six hand-honed wheels, rosewood finish handle, length 5½ inches. Turret holder may be revolved on or clamped to the frame. The cutters are protected when not in position for use **$0.40**

1140C. **Glass Cutter, Tubing.** For cutting glass tubing. Steel, nickel-plated, adjustable guide with set screw, highest grade cutters, length 11 inches..**$1.20**

1145C. **Glass Cutter, Tubing.** For cutting glass tubing up to 1 inch in diameter. The pressure on the cutting wheel may be regulated so as to be firm and even. Made of nickeled brass with steel cutting wheel. Illustrated in Chemical Apparatus Section **$1.00**

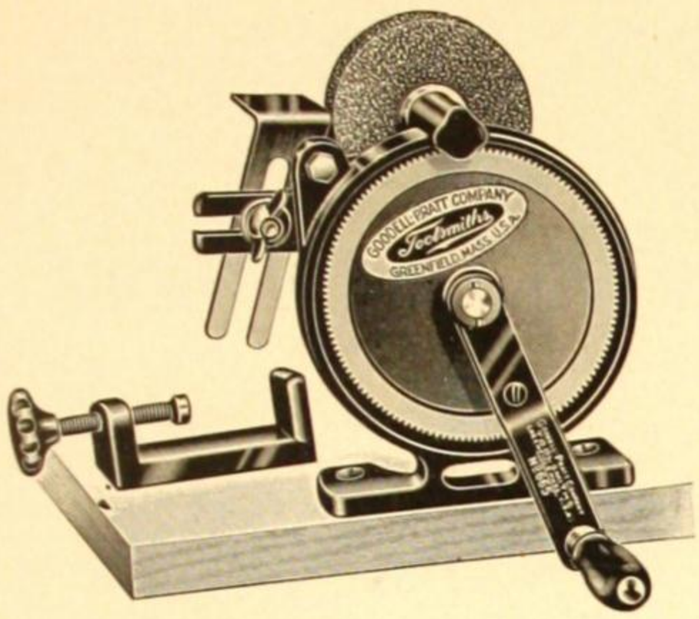
1150C. **Extra Cutting Wheels** for No. 1145C. Each **$0.10**

1155C. **Glass Knife.** For cutting glass tubing. Better than triangular files. Hardened steel, two-edge blade, hardwood handle. Total length, 8 inches..**$0.50**

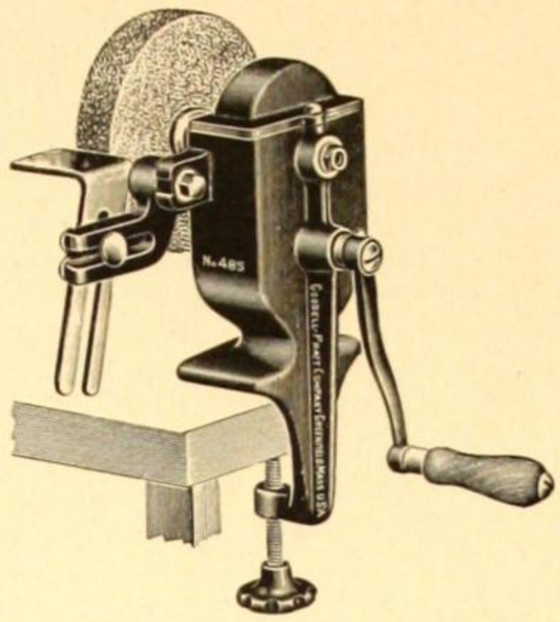
650D. **Glass Disk Cutter.** Goodell-Pratt. Has a graduated beam that can be firmly set to cut circles from 2 to 12 inches in diameter. Provided with high-grade cutter wheels. Each wheel is honed twice, and tested by actually cutting glass before being mounted in the tool. The standard has rubber base to prevent slipping.....**$1.50**

655D. **Glass Cutting Wheels** for No. 650D. Per dozen **$0.75**

660D. **Grindstone.** Improved ball bearing with fine, especially selected Berea grindstone, turned and rubbed smooth. Mounted in heavy iron trough on wood base. Nicely finished in blue enamel. A handy small grindstone for the laboratory shop. Seven-inch diameter **$5.00**



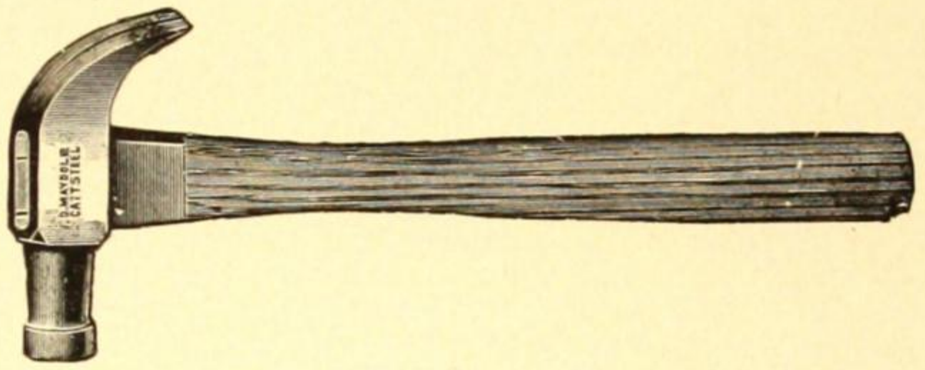
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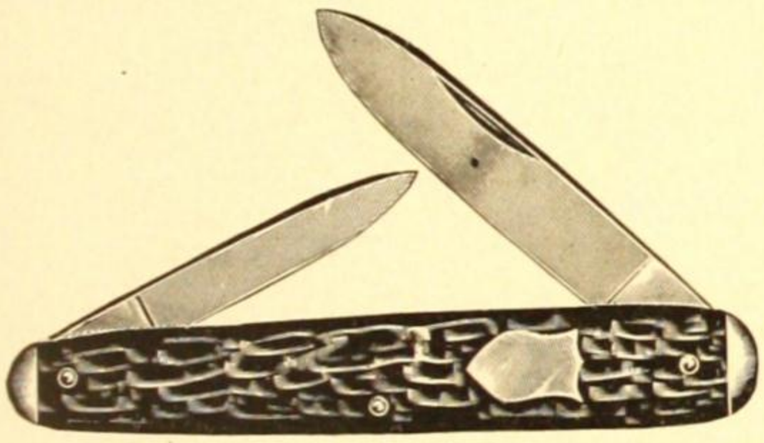
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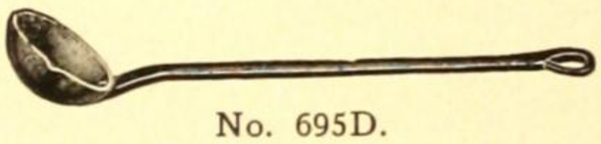
No. 675D.



No. 680D.



No. 690D.



No. 695D.

665D. Grinder, Bench. Goodell-Pratt. The large, solid gear is set deeply into the frame. The wide machine cut teeth insure smooth, quiet operation. The long steel crank, with its high mahogany finished handle, insures power with comfort. The steel pinion is entirely enclosed and carries a medium grit abrasive wheel, 4 in. in diameter with ¾ in. face. A clamp is furnished which will hold the grinder rigidly to any table or bench from ¾ to 2½ in. thick. If preferred, the grinder can be screwed down. A thoroughly efficient and reliable machine for grinding cutlery, edge tools, and innumerable other grinding jobs **$5.00**

670D. Grinder, Bench. High Speed. Goodell-Pratt. A series of gears causes the wheel to make 22 revolutions to each turn of the crank. Gears are completely inclosed; packed in grease. A high-grade abrasive wheel, 5x1 in., is furnished with each. Wheels are particularly selected for sharpening edge tools. Adjustable work rest is provided. Grinder will clamp to any bench less than 2¼ in..... **$9.00**

675D. Hammers. Steel Head, select white hickory handle. Useful for breaking ores or for riveting.

Weight, less handle, oz.	7	15
Each	**$1.25**	**1.50**

680D. Hammers, Claw. Tempered steel head, hickory handle.

Weight, ounces	7½	13
Each	**$1.10**	**1.20**

685D. Hatchet. Nineteen-oz. head with claw, 3½-in. cutting edge. Hickory handle..... **$1.50**

1214C. Knife, Laboratory. Round wood handle, four-inch steel blade. Excellent for cutting corks, etc.. **$0.25**

690D. Knife. Pocket. Finest tempered crucible steel blades. Two blades with stag handle. Length when closed 3 5/16 in. **$1.50**

695D. Ladle. Melting. With lip for pour-out. Wrought iron. Useful in fusing metals. Diameter of bowl 2½ in. **$0.50**



No. 705D.



No. 710D.



No. 715D.



No. 197B.



No. 730D.



No. 735D.

700D. Level. Bench, adjustable, with handle and accurately graduated vial. Length 4 inches, handle and tube nickeled, base japanned.....**$3.85**

705D. Level, Iron Bench. Ground face and ends, japanned body; double plumb, 12 inches.....**$2.75**

710D. Level, Instrument. Made of brass tubing, fully polished and nickeled. Used as attachment for electric and other machines. Ground flat on base.
Length, 2 inches **$0.40**
Length, 3 inches ..... .60

715D. Level, Pocket. This level is made from hexagon brass tubing, fully polished and nickel-plated.
Length, 2½ inches **$0.60**
Length, 3½ inches ..... .90

720D. Level, Pocket. Japanned iron, rounded ends, proved glass; length 3¼ inches.....**$0.30**

197B. Level, Round. For leveling up shelves, tables, balances, drying ovens, incubators, etc., diameter, 25 mm. **$1.75**

730D. Level, Mahogany. Goodell-Pratt. Made from seasoned mahogany. Brass binding rods dovetailed entire length, doweled to brass end plates. Vials set solid in stock as a double movable adjustment is used. Natural finish. Double plumb. 12x2x1 inches..**$4.25**

735D. Level, Rosewood. Goodell-Pratt. Level is made of four pieces of thoroughly seasoned rosewood built around a solid mahogany core. Brass binding rods are dovetailed the entire length and doweled to the heavy brass end plates. The side views are protected by brass plates. Accurately ground on inside. Made with double plumb. 24x 2½x1 3/16 inches **$9.50**

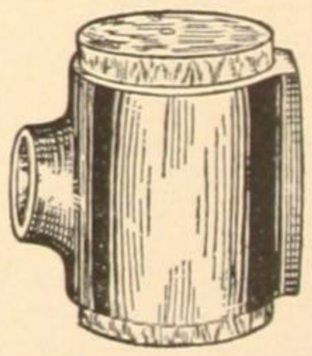
740D. Mallet. Wood. Round 3-inch face, long handle **$0.50**

745D. Maul. Cast iron with hickory face and handle. Weight, without handle, 10 lbs. **$1.80**

750D. Nail Set. Fine grade steel. Length, 4 inches, diameter at tip, 1/16 inch. Tips concave and tops oval, centers knurled **$0.15**



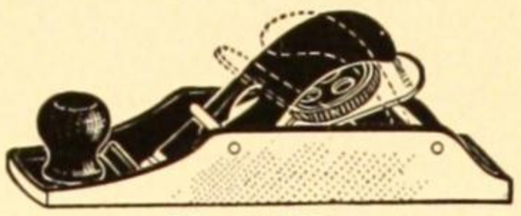
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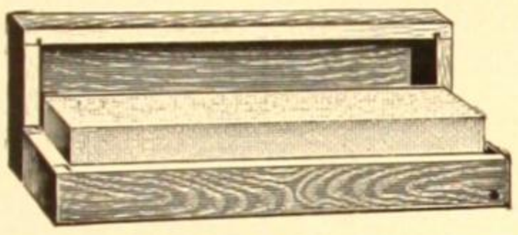
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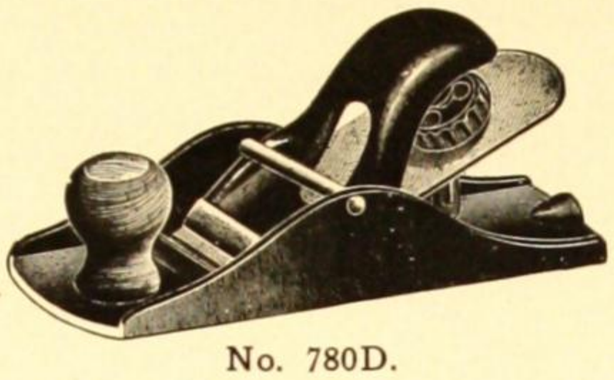
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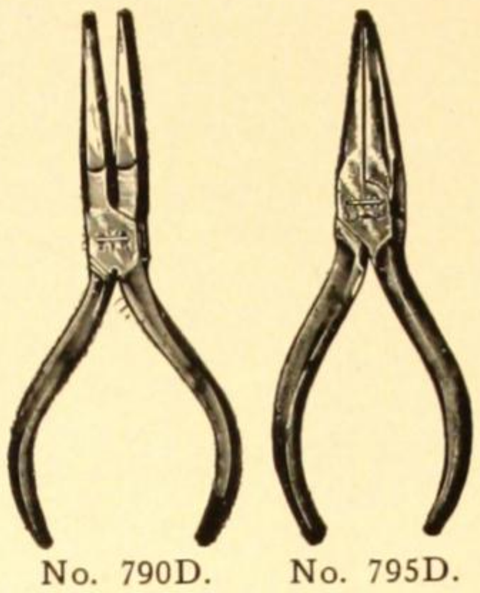
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No. 770D.



No. 780D.



No. 790D.

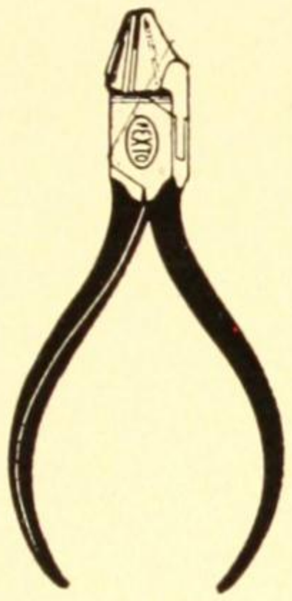
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No. 800D.



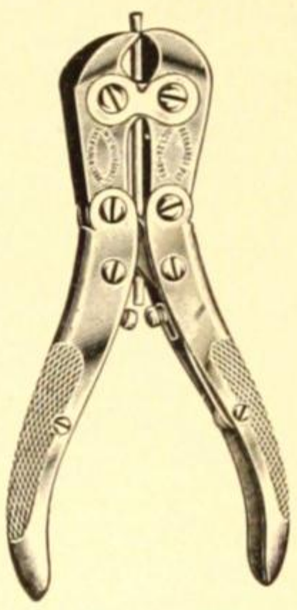
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No. 810D.



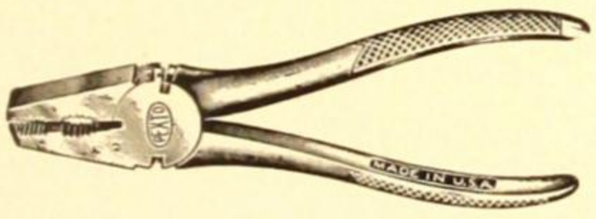
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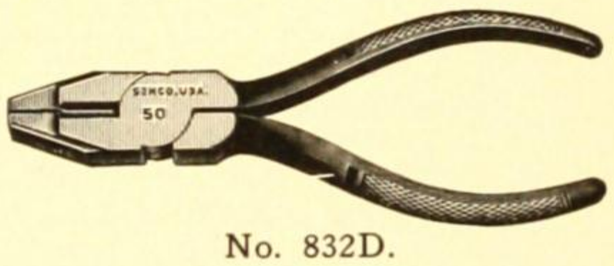
No. 820D.



No. 825D.



No. 830D.



No. 832D.

755D. Oil Can. Brass, nickel-plated. Capacity ½ oz. A long pin is attached to the inside of the cap which goes full length through the spout when oiler is covered. This assures free passage of oil when cap is removed. The construction of this oiler makes it very satisfactory for oiling instruments, small motors, etc. Height, 3½ in. **$0.20**

760D. Oil Can. Filled with spermoil. Otherwise same as No. 755D **$0.35**

765D. Oil Stone. Washita. Genuine, 6 in. unmounted **$0.75**

770D. Oil Stone. Washita. Genuine, 6 in. mounted in case **$1.00**

775D. Pantograph. For enlarging or reducing maps. Hardwood bars 20 in. long. For enlarging in 19 ratios. Trimmings are neat and substantial and the figures clean cut **$1.50**

780D. Plane. Block iron. Length, 5½ in. Cutter, 1⅜ in. **$1.10**

785D. Plane. Double-ender. Length, 8 in. Cutter, 1⅝ in. Can be used as a block plane, or by reversing the cutter and wedge it adapts itself to close up corner work **$2.25**

790D. Pliers, Flat Nose. Forged from special steel, close-fitting box joints; length, 5 in. **$1.10**

795D. Pliers, Round. Length, 5½ in. **$1.10**

800D. Pliers, Combination. Gas plier, wire cutter, wrench and screw driver. Length, 6 in. **$0.40**

805D. Pliers, Gas, cast steel, fine quality. Length, 8 in **$0.60**

810D. Pliers, Nippers, Diagonal Cutting. A handy cutting plier for places inaccessible to the ordinary plier. Length, 5 in. **$1.50**

815D. Pliers. End Cutting. (Nippers.) For cutting wire, pulling brads, etc. Length, 6 in. **$1.20**

820D. Pliers. Nippers. End cutting. Bernard's 6 in. Nickel-plated interchangeable parts. A compound system of levers makes this plier very powerful. **$3.50**

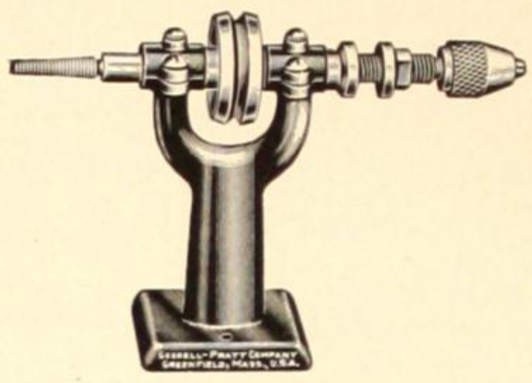
825D. Pliers, Wire Cutting, Bernard's. Full nickel-plated, parallel jaws, open throat. Length, 5½ in. **$2.25**

830D. Pliers, Wire Cutting. Button's patented. 6 inches **$0.80**

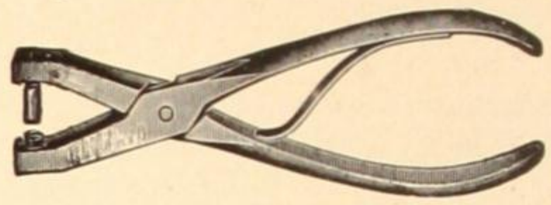
832D. Pliers, Side Cutting. Flat Nose. For cutting wire, etc. Length, 6 in. **$0.80**



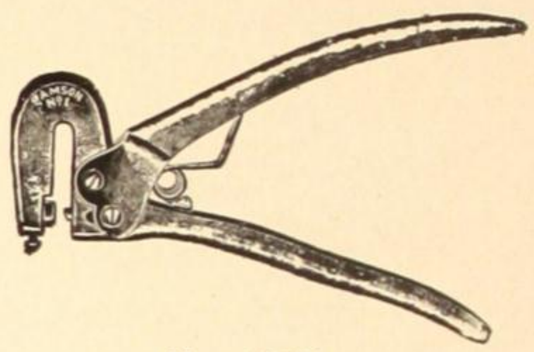
No. 835D.



No. 845D.



No. 880D.



No. 882D.

835D. Plumb Bob, Mercury. Starrett. 4 in. long, ½ in. diameter, weighs 3½ oz. The improvement consists in a patented device for fastening the string without a knot to tie or untie, simply by drawing it into the peculiarly slotted neck at the top, after unwinding the required length, when the bob will hang perfectly true.

These plumb bobs are made from solid steel, bored and filled with mercury. Noteworthy features are their great weight in proportion to size, low center of gravity, small diameter, hardened and ground points, knurling on the body and the simple and effective device at top for fastening end of line after winding up. Nickel-plated. Each is provided with a braided silk line **$1.80**

840D. Plumb Bob. Same as No. 835D, but made from solid steel, the mercury being omitted. Weight, 2¾ oz. **$1.00**

845D. Polishing Head. Goodell-Pratt. This machine has a ½ in. steel spindle, 10 in. long, provided with a taper screw on one end, and a three-jawed chuck, capacity 0 to ¼ in., on the other. It also has flanges for holding a wheel ¾ in. thick. The pulley is 2¼ in. in diameter and will take either ¼ in. round or ¾ in. flat belt. Iron parts are finished in red and black enamel; steel parts, polished. Height, 7 in. Net weight, 4¼ pounds..... **$4.50**

Accessories for No. 845D Polishing Head

850D. Circular Saw. 3 in. diameter with ½ in. center hole **$0.50**

855D. Emery Wheel. Best quality. 3 in. diameter, ½ in. thick with ½ in. center hole..... **$1.00**

860D. Felt Polishing Wheel. Best quality, 5 in. diameter, 1 in. thick, ⅛ in. center hole..... **$3.25**

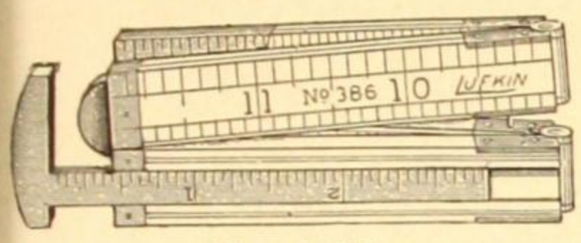
865D. Muslin Buff Wheel. 35 pieces of muslin attached together. 3 in. diameter, ½ in. center hole. **$0.40**

870D. Protractor and Goniometer. Penfield's. A graduated semi-circle printed on a heavy card, with an arm of transparent celluloid, swiveled on an eyelet at the center of the semi-circle. A fine index line on the underside of the celluloid arm indicates the angle. The instrument is an accurate goniometer for measuring plane angles. The millimeter scale, English diagonal scale, scales for 10ths, 12ths and 16ths of inches, and graduation of the semi-circle are all engine divided. Each instrument placed in a manila envelope with complete printed instructions by Prof. Penfield. Dimensions about 8x15 cm. **Each** **$0.60**

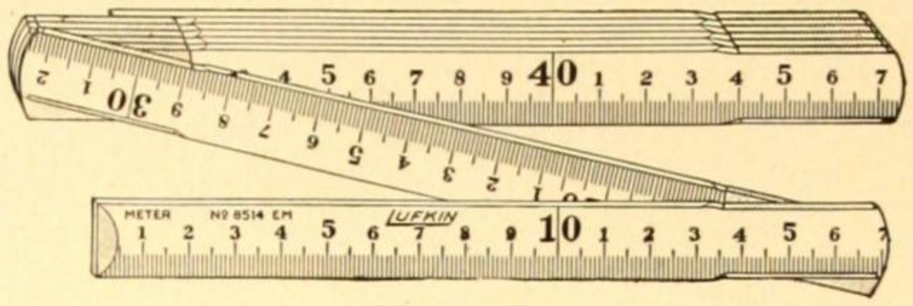
875D. Contact Goniometer. Penfield's Model B. As it is difficult to adjust a transparent edge in exact contact with some surfaces, a modified form of No. 870D is made for measuring crystals, having the celluloid arm opaque for a portion of its length. Dimensions about 6x10.5 cm. **Each**..... **$0.60**

880D. Punch. Spring. Single tube cast steel, for leather, etc. Length, 7½ in., diameter of hole punch, ¼ in. **$0.90**

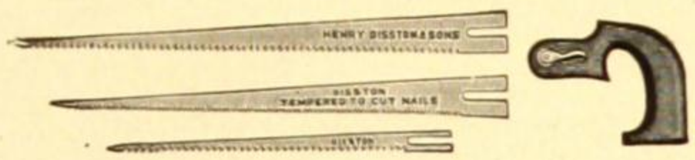
882D. Punch, Paper, Samson. A very powerful hand punch, nickel-plated and fitted with $\frac{3}{16}$ in. die. Will perforate light sheet steel and any paper up to ¼ in. **$3.00**



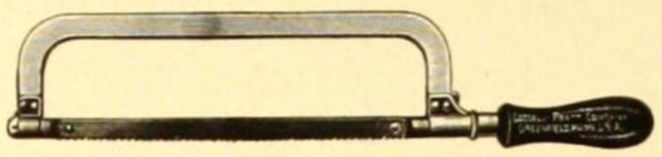
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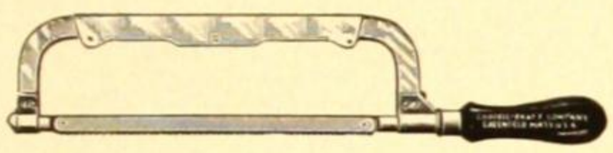
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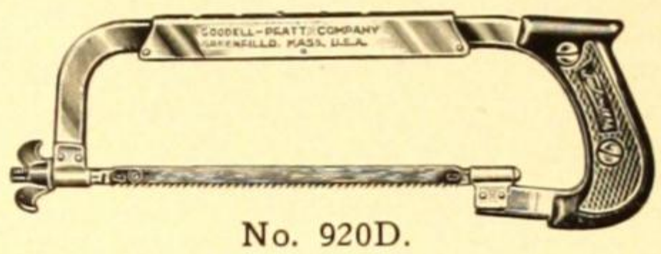
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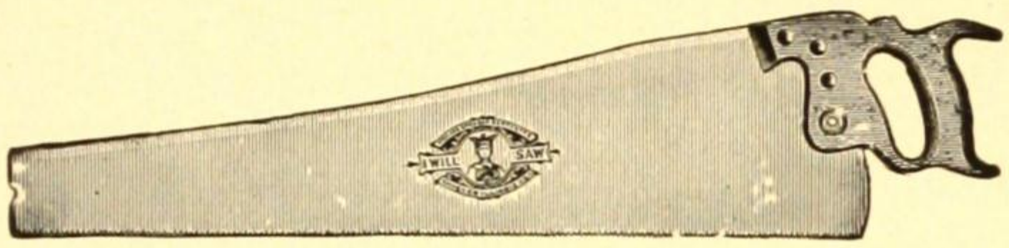
No. 910D.



No. 915D.



No. 920D.



Nos. 905D-935D.

Rulers, All Kinds, Section M

Pages 250-257

885D. Rule. English and Metric. With brass caliper extension for diameters up to 2¾ in. or 70 mm. Boxwood, 12 in. long in 1/16ths of an inch. Four fold **$1.00**

890D. Rule. English and Metric. 6 fold, 36 in. by 1/16ths of an inch. Other side in millimeters. Boxwood **$0.35**

900D. Saw. Combination. Beechwood handle with wing nut tightener. Nest of 3 Blades includes 11½ inch keyhole and 13½ inch compass blade, 18 inch panel saw ..... **Each $2.25**

905D. Saw. Crosscut. Length, 26 in. Cast steel, good quality **$2.00**

910D. Saw, Hack. Made of fully polished and nickel-plated steel. Tension on blade secured by turning handle. For 8 in. blades only. One blade furnished with frame **$1.55**

915D. Saw, Hack, Adjustable. Goodell-Pratt. This frame has a white nickel finish. Adjustable from 8 to 12 inches, and designed so that the blade can be faced in four different ways. Complete with one 8 inch blade **$1.80**

920D. Saw, Hack. Adjustable from 8 to 12 inches. Of 1/3 x 3/4 in. steel with an extra heavy back, which gives additional rigidity. The black composition handle is molded in a single piece peculiarly shaped to give a comfortable grip. Frame is so designed that it balances well and hangs nicely. One blade furnished with each frame. Fully polished and nickel-plated **$3.85**

925D. Saw Blades. Hack, Goodell-Pratt. Excellent quality, Tungsten steel. For cutting iron and steel rods or bars, 14 teeth to an inch.

Length, inches	8	12
Per dozen	**$0.75**	**1.10**

930D. Saw Blades. Hack. Same as No. 925D, but with 20 teeth to the inch. For brass pipe or tubing.

Length, inches	8	12
Per dozen	**$0.80**	**1.25**

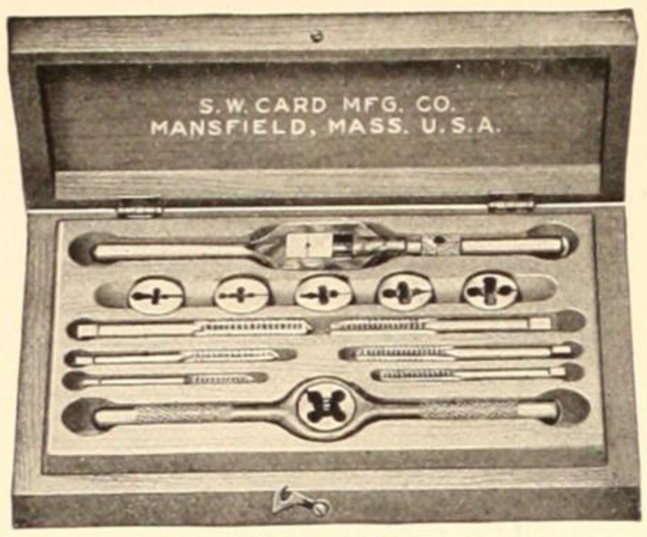
935D. Saw. Rip. Length, 26 in. Cast steel, good quality **$2.50**



No. 940D.



No. 945D.



No. 950D.



No. 955D.

940D. Screw Dies. Round, adjustable, 5/8 in. diameter, 1/4 in. thick. In ordering please specify screw gage No. and No. of threads to the inch.

Screw gage No...	2	4	6	6	8	8	10	12	14
Approximate diam., in. ..	5/16	7/64	9/64	9/64	5/32	5/32	3/16	7/32	1/4
No. threads to inch....	56	36	32	40	32	40	32	24	20
Each **$1.00**	**.75**	**.75**	**.75**	**.75**	**.75**	**.75**	**.75**	**.75**	

945D. Screw Die Stock. For holding No. 940D Dies **$0.80**

950D. Screw Die and Tap Set. With stock 7 in. long. Tap wrench 7½ in. long. 6 dies 13/16 in. diameter and 6 taps cuttings threads 4-36, 6-32, 8-32, 10-24, and 14-20. In hardwood box as illustrated..**Per set $9.00**

955D. Screw Die and Tap Set. With stock 9 in. long. 5 dies 1 in. diameter and 5 taps cutting threads ½-20, 5/16-18, 3/8-16, 7/16-14 and ½-12. In hardwood box as illustrated .....**Per set $9.00**

960D. Screw Driver. Electrician's. Designed for electrical work, having a thoroughly insulated hammer forged tool steel blade. Six-sided mahogany finish handle, giving a sure but comfortable grip. Blade size, 4 in. **$0.35**

965D. Screw Driver. Jeweler's. For delicate work. Mahogany finish hardwood handle. Blade of best steel. 3 in. blade.....**$0.35**

970D. Screw Driver. Plain. Handle is polished hardwood with longitudinal corrugations to keep the hand from slipping. Blade is 2 inches long....**$0.30**

975D. Screw Driver. Pocket Set. The set consists of a hollow handle, with a chuck, and four small screw driver blades. When not in use the chuck and blades are contained inside the handle. The blades are made of tool steel and will give satisfactory service. Handle is handsomely polished, nickel-plated and buffed. Length, closed, 3¼ in.....**$1.20**

980D. Screw Driver. Ratchet. A very high grade ratchet screw driver. To change from right to left or rigid, turn the knurled ferrule. Blade 6 inches long **$1.20**



No. 960D.



No. 965D.



No. 970D.



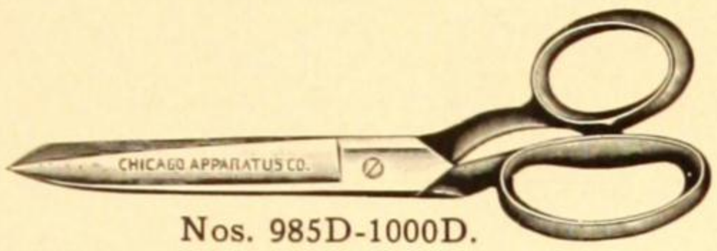
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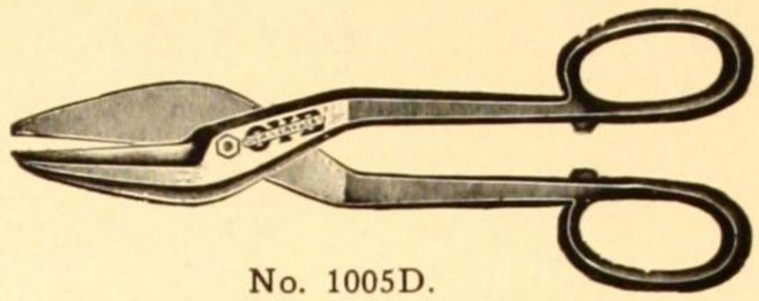
No. 975D.



No. 975D (With blades in hollow handle).



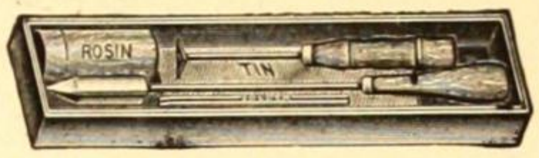
Nos. 985D-1000D.



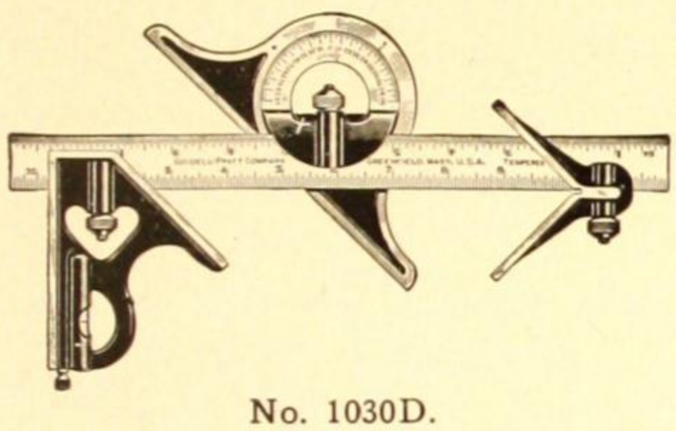
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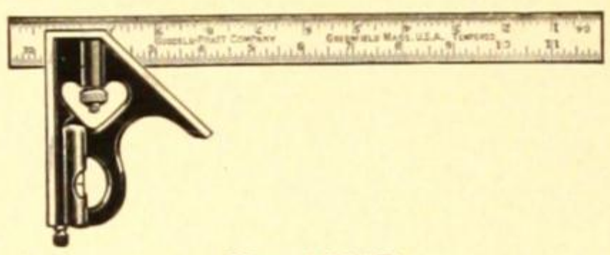
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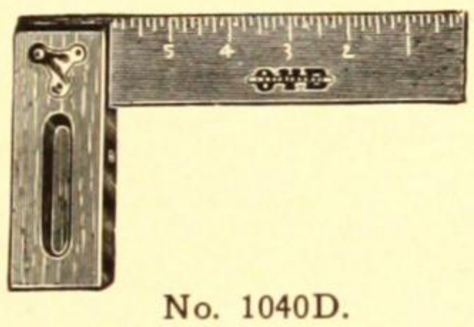
No. 1024D.



No. 1030D.



No. 1035D.



No. 1040D.

985D. **Shears, Paper.** High-grade steel, length of blade 4 inches, total length, 8 inches.....**$0.75**

990D. **Shears, Paper.** High-grade steel, length of blade 6 inches, total length 10 inches.....**$1.35**

1000D. **Shears, Paper.** High-grade steel, length of blade, 8 inches, total length 12 inches.....**$1.80**

1005D. **Shears.** Tinner's snips; for cutting metal. Lengths of cut, 2½ inches.....**$1.00**

1010D. **Solder.** Wire form, half lead and half tin, ⅛ inch diameter .....**Per pound package $0.85**

1012D. **Solder.** Wire form, with resin center. Requires no flux, therefore makes splices corrosion-proof. Extensively used in soldering joints in electrical devices and circuits. ..**Per pound package $1.50**

1015D. **Soldering Copper,** ½ pound, with wooden handle **$0.50**

1020D. **Soldering Copper.** Jeweler's 1-ounce, for instrument repairing **$0.30**

1022D. **Soldering Copper, Electric.** For radio and similar work, for 110-volt A.C. or D.C.....**$2.50**

1024D. **Soldering Set.** Soldering copper, scraper, stick of solder, box of rosin, in neat box.....**$0.60**

1025D. **Soldering Paste.** In metal cans. Easy application, non-corrosive, non-acid, fumeless.

Size, ounces	2	8
Each	**$0.30**	**.80**

1030D. **Square, Combination.** Goodell-Pratt. A very handy tool. Equipped with beam, center head, and protractor. Can be used as a rule, square, miter, depth gauge, height gauge, level, center head and for angle work by using the protractor. Metric and English graduations, 12-inch or 30-cm. blade...**$7.80**

1035D. **Square, Combination.** Goodell-Pratt. Same as No. 1030D, but without center head and protractor **$3.60**

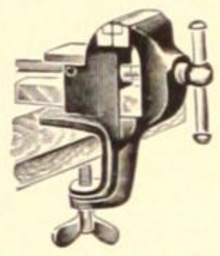
1040D. **Square. Try.** 6-inch blued steel blade, graduated in 8ths of an inch. Polished rosewood handle, brass face plate **$0.70**

1050D. **Stencil Figures.** Each figure has a beaded lock on its edge so that they can be joined, permitting combinations. Set consists of one-inch numbers from 0-9, dollar and cent marks, beginner, ender, and period .....**Per set $0.70**

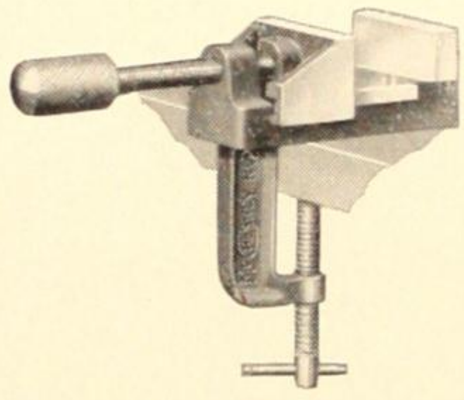
1055D. **Stencil Letters.** Same as No. 1050D. Set consists of one-inch letters from A-Z with beginner, ender, period, apostrophe, $, comma and blank. **Per set** **$1.35**



No. 1060D.



No. 1065D-1070D.



No. 1072D.



No. 1075D.



No. 1080D.



No. 1085D.

1060D. Tool Set. Goodell-Pratt. This set contains an assortment of high-grade tools of exceptional value in the workshop. The following tools are contained in the set: Automatic Drill; 8 Drill Points, $\frac{1}{16}$ to $\frac{11}{64}$ inch; Glass Cutter; Hack Saw Frame; Hack Saw Blades; Polished Bone Saw; Spoke Shave; Ratchet Screw-Driver, 1½ inch; Ratchet Screw-Driver, 6-inch; Small Oil Stone; Tool Handle; Solid Punch; Saddlers' Punch; Prick Punch; Nail Set. Size of case, 16x8¼x3¼ inches. Net weight, 6 lbs. **$13.75**

Vises, Anvil Clamp. Iron jaws, wrought iron screw, for clamping to table top or work bench.

Cat. No.	1065D	1068D	1070D
Width of jaws, inches	1¾	2½	3
Weight, pounds	2	4	7
Each	**$1.75**	3.50	5.00

1072D. Vise, Instrument Makers. The jaws are 2 inches wide by ¾ inches high and can be separated 1¾ inches. Tops, sides, and insides of the jaws being precision ground, match perfectly. Therefore they will hold small parts securely with a minimum of pressure. The clamp is removable and will fit any table top 1¾ inches thick or less **$2.25**

1075D. Wrench, Monkey. Good quality; length, 8 inches **$0.80**

1080D. Wrench, Monkey, Pocket. Length, 5 inches. 1½ inch opening. Thickness of jaws, $\frac{5}{16}$ inch.. **$0.40**

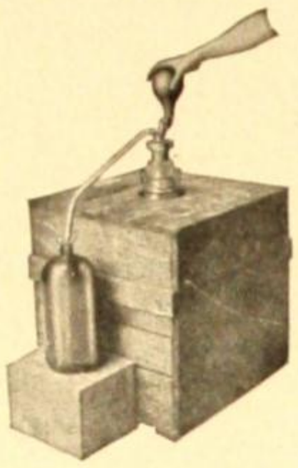
1085D. Wrench, Stillson's Pipe. Length, 10 inches; takes pipe from ⅛ to 1 inch **$1.50**

Chemical Apparatus

Section C



No. 2C.



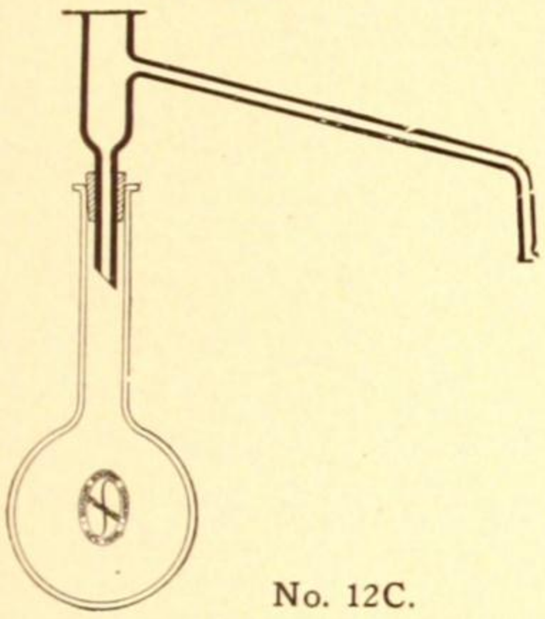
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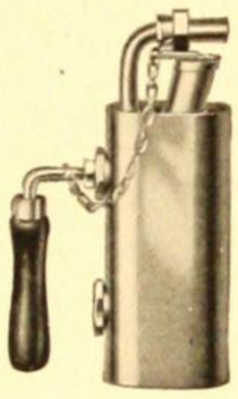
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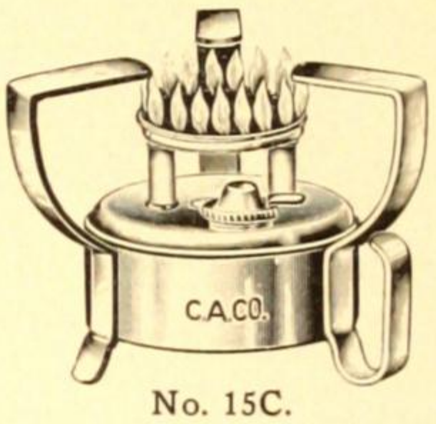
No. 10C.



No. 12C.



No. 14C.



No. 15C.

2C. Acid Pitcher. Made of stoneware, with pour-out.

Capacity, quarts	2	4
Each	$0.65	.80

3C. Acid Pump. A perfected device for the safe and easy handling of acids and other liquids contained in carboys. This pump operates much faster than a siphon as it has a capacity of approximately two gallons per minute, which can be increased by squeezing the bulb more rapidly. To operate, the bulb is squeezed, forcing air into the carboy through the valves; this in turn forces the liquid out through the continuous lead pipe which reaches to the bottom of the carboy. When it is desired to stop the flow, the relief valve is pressed upward which permits the air to escape. The lead flow pipe has no connection with the valve body, and when withdrawn no acid remains in it. Every laboratory using acid in carboys should have this pump..... **$7.50**

5C. Adapters, Curved. Of light glass, bent at an angle of 45° for use with retorts and condensers.

No.	A	B	C
Length, mm.	150	180	200
Diameter, large end, inside mm.	18	25	30
To take rubber stopper No.	2	5	6
Each	$0.22	.25	.30

10C. Adapters, Straight. Otherwise same as No. 5C.

No.	A	B	C
Length, mm.	150	180	200
Diameter, large end, inside mm.	18	25	30
To take rubber stopper No.	2	5	6
Each	$0.22	.25	.30

12C. Adapter, Distilling, Stansico. Designed to fit the ordinary flask for making distillations. It is connected to the flask by a rubber or cork stopper forming a tight but rigid joint, thus lessening the liability of injury when used in the laboratory. Offers many advantages:—flask may be easily removed for refilling without disturbing other connections—reduces shipping and handling breakage to a minimum—adapter may be transferred to other types of flasks if desired—less costly than distillation flasks. With bent delivery tube and narrow stem. Price of adapter only, without flask or stopper. **$0.60**

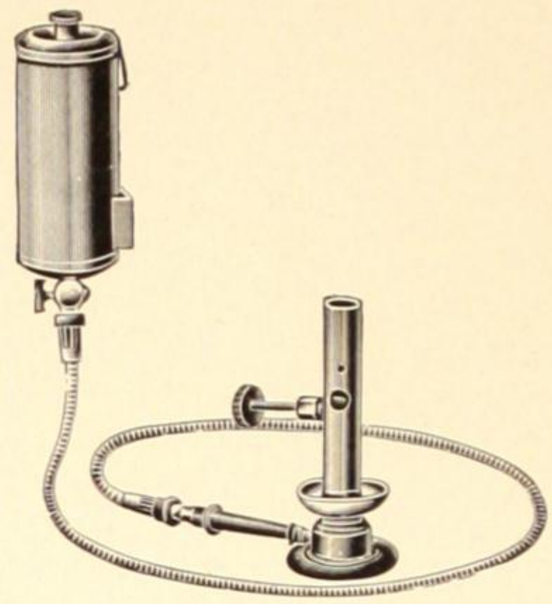
13C. Adapter, Distilling. Same as No. 12C, but with straight delivery tube and larger stem for inserting thermometer **$0.60**

14C. Alcohol Blow Torch. This is an improved blow torch which is automatic in action. It has all the desirable features without any of the undesirable ones and we recommend it unconditionally. It is oval in shape and very compact. It has a strong blast, generating a heat of 2000° Fahr. which melts copper. The cap, which locks on to prevent evaporation, is secured with a heavy chain. The Torch is made of heavy gauge brass, nickel plated, and is leakproof. It has a wood handle which stays cool. It will burn two hours with each filling of denatured alcohol. Size, inches, 7x4⅜x1⅝..... **$3.00**

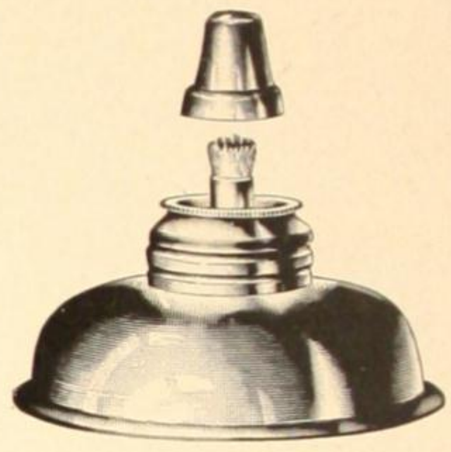
15C. Alcohol Burner. So arranged that gas is generated by vaporizing the alcohol. Will boil a quart of water in nine minutes and will burn for more than one hour with one filling. (Note: For replacing wicks in No. 15C order No. 42C)..... **$1.25**



No. 17C.



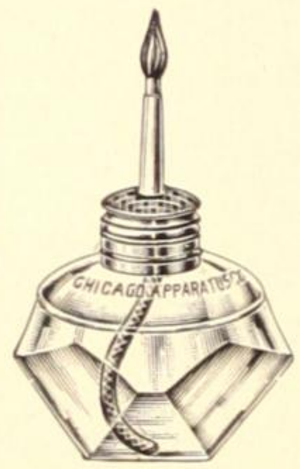
No. 18C.



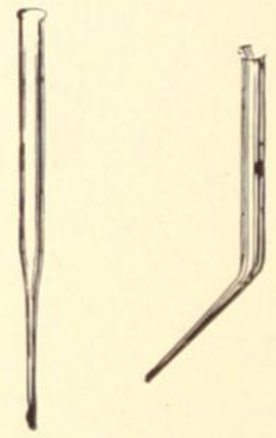
No. 20C.



No. 25C.



No. 41C.



No. 43Ca-No. 43Cb.



No. 45C. No. 51C.

17C. Alcohol Burner, Barthel's. Burns 90 minutes, with a blue, smokeless flame on one charge. Melts Copper wire 3 mm. diameter in 1½ minutes..**$9.50**

18C. Alcohol Burner, Barthel's. Automatic in its action, requires no wick, very powerful. Produces a flame equivalent to two Bunsen burners. Complete, with five feet flexible steel tubing and reservoir of one quart capacity.....**$11.00**

534C. Extra Flexible Steel Tubing, for No. 18C, 60 inches long **$0.75**

20C. Alcohol Lamps, Brass. With brass screw cap, wick holder and wick, capacity 4 ounces.....**$0.90**

25C. Alcohol Lamps, Glass. Heavy glass font, ground glass cap, brass wick holder.

Cat. No.	25C	26C
Capacity, ounces	4	8
Each	**$0.50**	.60

35C. Alcohol Lamp Wicks. For Nos. 20C and 25C alcohol lamps .....**Per dozen $0.20**

40C. Alcohol Lamp Wick Holders. Brass, for No. 25C alcohol lamps.....**Per dozen $0.90**

41C. Alcohol Lamp, Glass. Extra large. With ½-inch wick. Gives much hotter flame than ordinary lamps. Font has nine facets, enabling it to be placed in any position.....**$0.75**

42C. Alcohol Lamp Wicks for Nos. 41C and 15C. **Per dozen** **$0.80**

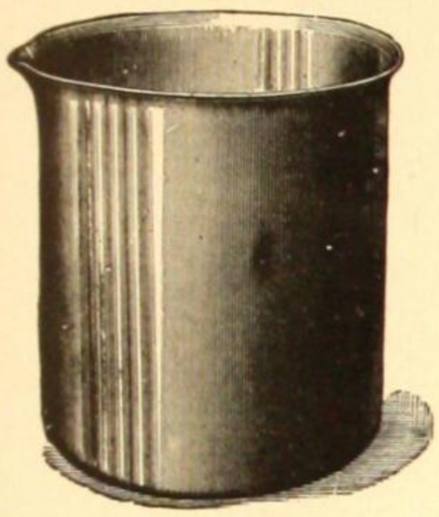
43C. Arsenic Tubes. Of hard glass.

Cat. No.	43Ca	43Cb
Each	**$0.10**	.10

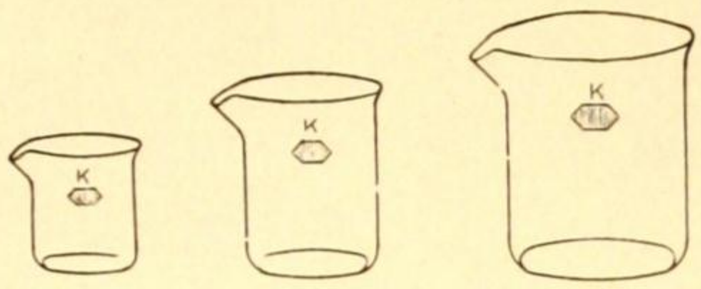
45C. Asbestos Mats, Round. 8½-inch diameter, tin bound edge **$0.12**

51C. Asbestos Mats, Square. 1/16-inch thick.

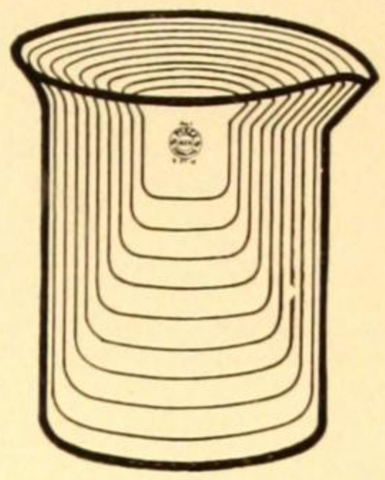
Cat. No.	51C	52C
Sizes, inches	5x5	6x6
Dozen	**$0.40**	.50



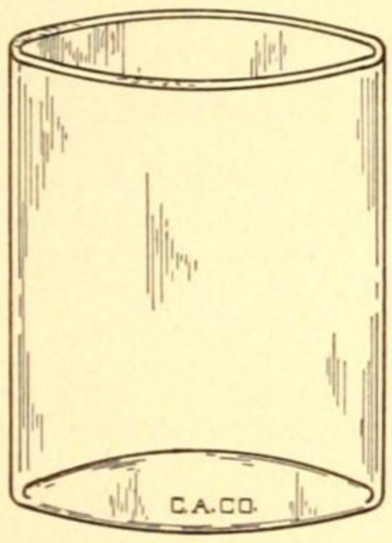
Nos. 55C-60C.



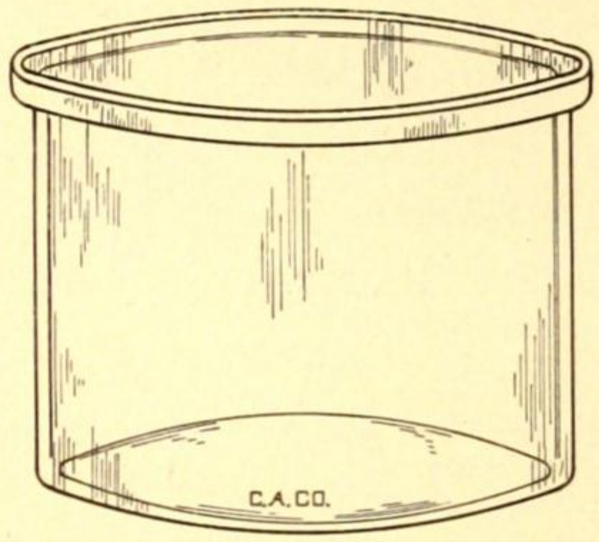
Nos. 65C-69C-70C.



No. 75C.



No. 580B.



No. 590B.

55C. Beakers, Aluminum. With lip (pourout).

Capacity, cc.	125	250	500	1000
Each	**$0.55**	**.70**	**1.20**	**1.80**

60C. Beakers, Copper. With lip (pourout).

Capacity, cc.	125	250	500	1000
Each	**$0.75**	**.90**	**1.20**	**1.80**

65C. Beakers, Glass, Resistant Glass. Griffin's low form, with lip (pourout). (20% discount when ordered in original cases.)

Cap., cc.	50	100	150	250	400	600	800	1000
No. in orig. case	190	140	120	160	90	70	70	50
Each	**$0.15**	**.17**	**.19**	**.21**	**.25**	**.30**	**.34**	**.50**

69C. Beakers, Glass, Resistant Glass. Nest of five, one each No. 65C, sizes 50 cc. to 400 cc.

Per nest **$0.95**

70C. Beakers, Glass, Resistant Glass. Nest of seven, one each No. 65C, sizes 50 cc. to 800 cc.

Per nest **$1.60**

75C. Beakers, Glass, Pyrex, Griffin's low form, with lip (pourout). (10% discount when ordered in original cases.)

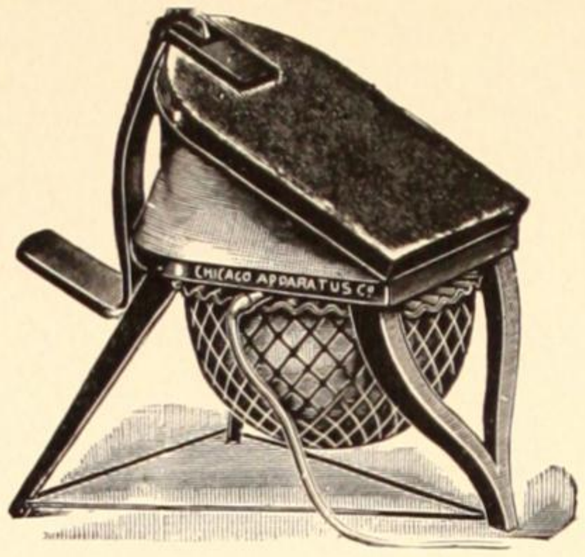
Cap., cc.	50	100	150	250	400	600	800	1000	1500	2000
No. in org. case	120	156	156	168	84	72	48	48	24	12
Each	**$0.18**	**.19**	**.21**	**.25**	**.30**	**.35**	**.40**	**.54**	**.73**	**.98**

580B. Aquaria (Battery Jars). Clear white glass.

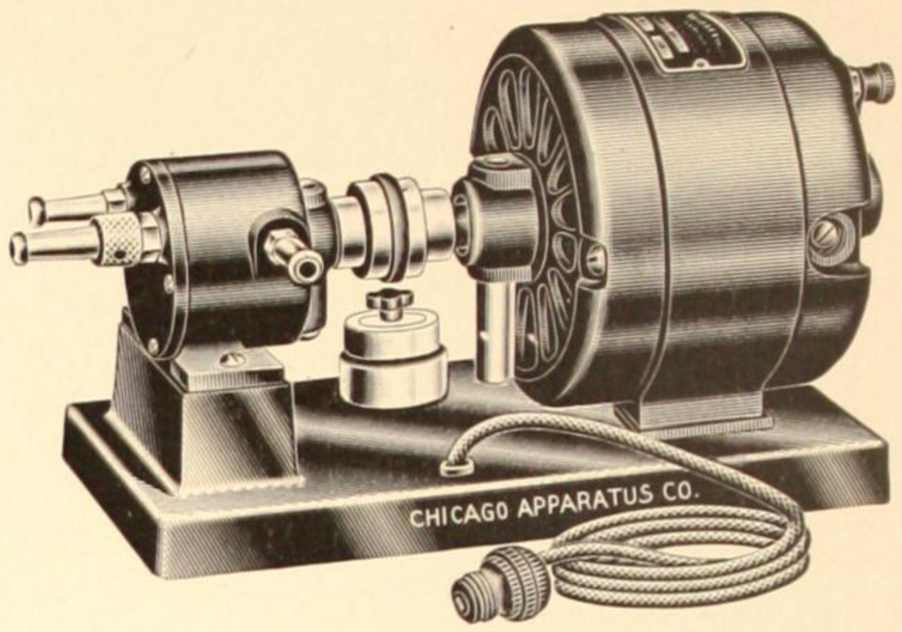
Diameter, inches	4	5	6	9
Height, inches	5	7	8	12
Each	**$0.75**	**.90**	**1.50**	**3.60**

590B. Aquaria, Round. White glass, re-enforced rim.

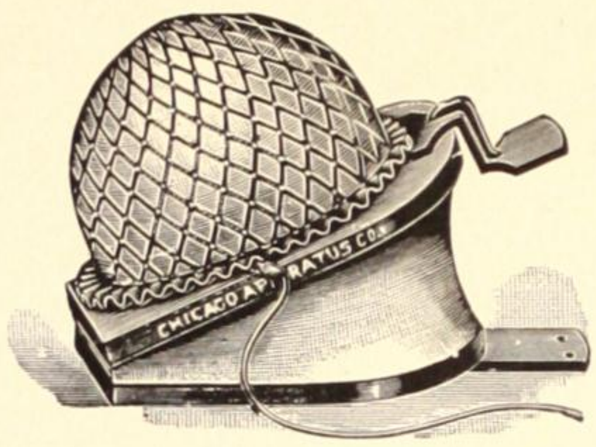
Diameter, inches	7	9	10	12
Height, inches	7	9	10	12
Capacity, gallons	1	2	3	5
Each	**$2.20**	**3.30**	**5.50**	**7.50**



No. 80C.



Nos. 91C-93C.



No. 83C.



No. 95C.

80C. Blowers, Foot, Fletcher's. Made in three sizes. For ordinary blowpipe work the small size is best adapted; for larger blowpipes, blast burners, or small melting furnaces the medium size; and for the largest blowpipes, blast burners, melting furnaces the large size. Genuine Fletcher blowers, the recognized standard for over 25 years. Mounted on legs with rubber reservoir underneath, eliminating danger of injury.

Size	Small	Medium	Large
Manufacturer's No.	10	10A	10B
Blast pressure, per square inch, lbs.	1	1½	1¾
Size of boards, in.	7¾x9	10x11	11½x13¾
Each	**$11.00**	**14.25**	**20.00**

83C. Blowers, Foot, Fletcher's. Same as No. 80C, but not mounted on legs.

Size	Small	Medium	Large
Manufacturer's No.	9	9A	9B
Each	**$9.50**	**12.50**	**18.00**

87C. Rubber Disks. For Nos. 80C and 83C Blowers.

Size	Small	Medium	Large
No. of disks required	1	2	3
Diameter, inches	9⅛	11½	14¼
Each	**$0.50**	**.80**	**1.25**

90C. Nets. For Nos. 80C and 83C Blowers.

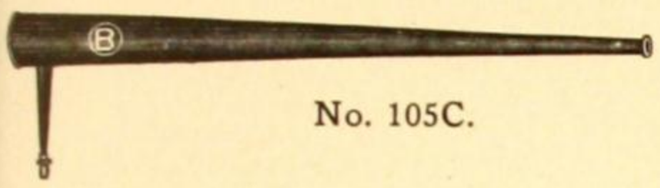
Size	Small	Medium	Large
Each	**$0.60**	**.65**	**.70**

91C. Blower and Vacuum Pump Combined, Milvay Rotary, Electrically Driven, A.C. Far more convenient than bellows in operating blast lamps, organ pipes, siren disk air jet attachments, etc. Far more convenient than air pumps in operating devices requiring a moderate vacuum. Small size, compactness, few parts and freedom from mechanical troubles are features which characterize this efficient little machine. Occasional oiling is the only attention ever required. A slip-ring valve on the outlet tube provides a simple means for varying the air pressure. Hose ends for rubber tubing form the inlet and outlet for the water jacket surrounding the blower. This makes it extremely easy to circulate water through the jacket and thus carry away the heat developed by compression during continuous use. Pressure at maximum speed, 7 lbs. per square inch; vacuum at maximum speed, 16 inches of mercury; cubic feet of air per minute, 0.75; will operate two blast lamps simultaneously. Size of base, 5x9½ inches. Complete with 1/20 H. P. direct connected motor, pressure regulator, switch, cord and plug. Iron parts finished in gloss-black enamel, other metal parts in nickel-plate. For use on 110-volt alternating current circuit **$45.00**

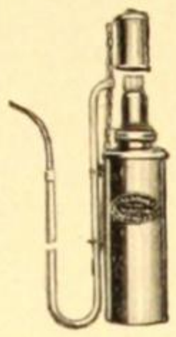
93C. Blower and Vacuum Pump Combined, Milvay Rotary, Electrically Driven, D.C. Same as No. 91C, but equipped with motor for use on 110-volt direct current circuit **$50.00**

95C. Blowers, Hand. Diameter, 7 inches **$2.00**

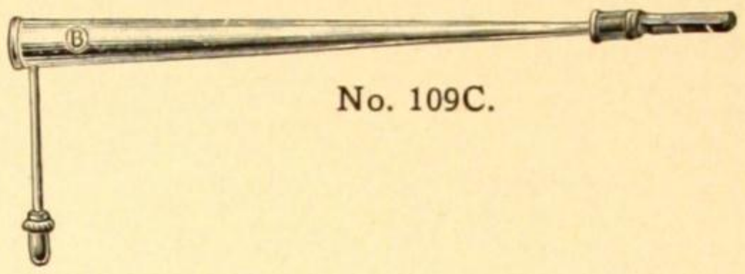
100C. Blowers, Hand. Made of pure rubber, two bulbs, one covered with net for constant pressure **$2.00**



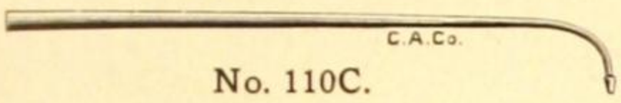
No. 105C.



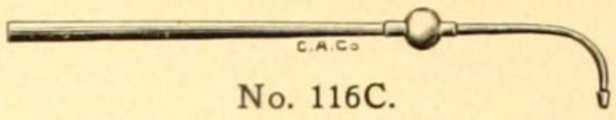
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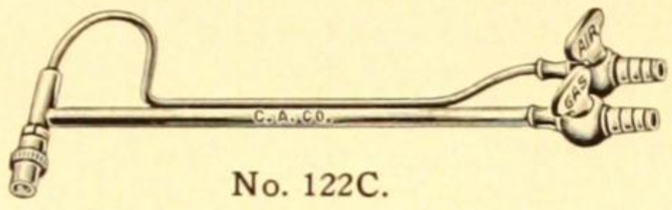
No. 109C.



No. 110C.



No. 116C.



No. 122C.

105C. **Blowpipe, Black's.** Japanned tin, length 8½ inches, with removable brass tip.....**$0.20**

108C. **Blowpipe Tips.** For renewing tips on No. 105C .....**Per dozen $1.25**

109C. **Blowpipe, Black's.** Improved form of brass, with wooden mouthpiece and removable tip that unscrews **$0.90**

110C. **Blowpipes, Brass, Plain.**

Cat. No.	110C	111C
Length, inches	8	10
Each	**$0.18**	**.20**

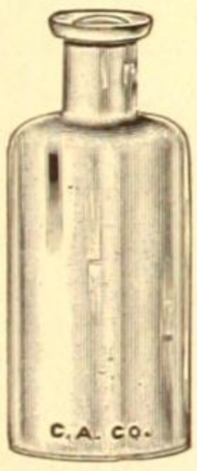
112C. **Blowpipe, Alcohol Torch.** A fine pointed flame is produced with this torch that is suitable for radio work or any other purpose where a small flame is required. The reservoir is made of drawn brass and is filled by removing the burner top and the cap screws down tightly preventing evaporation. The blowpipe is adjustable so that it is suitable for the particular work which it is to perform. Complete with rubber tube and mouthpiece as illustrated.**$2.50**

116C. **Blowpipes, Brass, with Bulb or Air Chamber.** Length, 10 inches.....**$0.40**

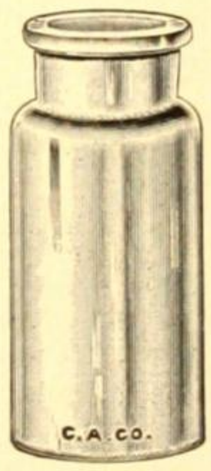
120C. **Blowpipe, Brazing.** Brass, with stopcocks of air and gas. Size of air tube, 3/16 inch; of gas tube, 7/16 inch; length over-all, 14 inches. Requires 3/8 inch gas supply **$3.00**

122C. **Blowpipe, General Laboratory.** Convenient because of its weight, shape, and size for sealing glass and repairing pieces not easily handled. Provides intensely hot flame, which by means of the separate stopcocks on the gas and air tubes, is easily regulated from the largest brush down to the finest needle flame. Made entirely of brass, nickel plated. Length, 9 inches. Weight, 5 ounces.....**$6.00**

Bottles of All Kinds



No. 125C.



No. 130C.

125C. **Bottles.** Narrow mouth, round, flint glass. (20% discount when ordered in original cases.)

Capacity, ounces	1	2	4	6	8	12	16	32	64	1 gal.
To take cork stopper, No.	1	2	3	4	5	5	6	7	9	11
No. in original case	864	720	432	360	288	216	144	72	48	24
Per dozen	**$0.50**	**.60**	**.75**	**.90**	**1.00**	**1.20**	**1.30**	**2.00**	**3.60**	**5.50**

130C. **Bottles.** Wide mouth, round, flint glass. (20% discount when ordered in original cases.)

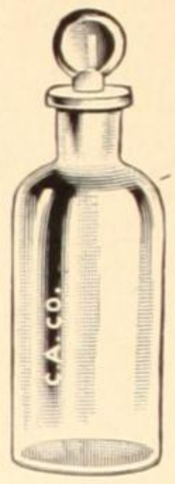
Capacity, ounces	1	2	4	6	8	12	16	32	64
To take cork stopper, No.	8	12	14	14	18	18	20	26	..
To take rubber stopper, No.	2	4	5	6	7	7	8	9	13
No. in original case	864	720	432	360	288	216	144	72	48
Per dozen	**$0.50**	**.60**	**.75**	**.90**	**1.00**	**1.20**	**1.30**	**2.00**	**3.60**



No. 132C.



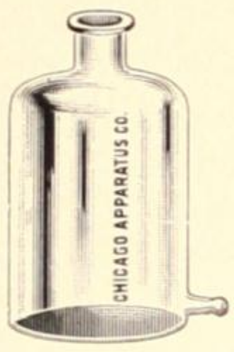
No. 135C.



No. 137C.



No. 140C.



No. 145C.



No. 150C.



No. 155C.

132C. Bottles. Extra wide mouth, round, flint glass. So-called "Jar-style Specimen Bottles." (20% discount when ordered in original cases.)

Capacity, cc.	30	50	75	100	150	200
Diam. of body, mm..	43	50	57	62	66	70
Ht. over all, mm....	50	60	65	70	85	96
To take cork No. ...	13	15	15	22	22	22
To take rubber stopper No.	6	6	6	9	9	9
No. in original case.	864	720	576	432	360	288
Per dozen	**$1.30**	**1.40**	**1.65**	**1.85**	**2.10**	**2.45**

135C. Bottles. Glass stoppered, narrow mouth (tinctures), mushroom stopper. (20% discount when ordered in case lots.)

Capacity, ounces	1	2	4	8	16	32
No. in original case....	864	720	432	288	144	72
Per dozen	**$2.40**	**2.60**	**3.10**	**4.50**	**5.50**	**7.50**

137C. Bottles. Glass stoppered, narrow mouth (tinctures), reagent stopper. (20% discount when ordered in original cases.)

Cap., oz. ..	1	2	4	8	16	32	..	..
Cap., gal...	..	..	..	..	..	..	½	1
No. in orig. case	864	720	432	288	144	72	48	24
Per dozen	**$2.50**	**2.75**	**3.20**	**4.60**	**5.75**	**8.00**	**14.40**	**27.00**

140C. Bottles. Glass stoppered, wide mouth (salt mouth), flint glass, mushroom stopper. (20% discount when ordered in original cases.)

Capacity, ounces	1	2	4	8	16	32
No. in original case....	864	720	432	288	144	72
Per dozen	**$2.50**	**2.75**	**3.25**	**4.65**	**5.75**	**8.00**

143C. Bottles, Acid. Narrow mouth, green glass, with vertical glass stopper, ½ gallon. (20% discount when ordered in lots of 36 or more.)

Each **$0.65**

145C. Bottles, Aspirator. Heavy flint glass, with outlet at bottom for connecting rubber tubing.

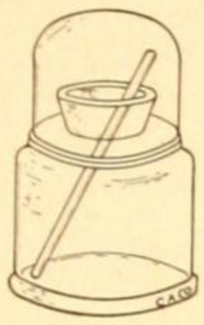
Capacity, ounces	4	8	16	32
Each	**$0.80**	**.90**	**.95**	**1.25**
Capacity, gallons	½	1	2	
Each	**$1.80**	**2.75**	**4.50**	

150C. Bottles, Aspirator. Heavy flint glass, with tubulature at bottom for stopper.

Cap., gallons	½	1	2	3	5
Each	**$1.50**	**2.50**	**4.00**	**7.00**	**13.50**

155C. Bottles, Aspirator. Heavy flint glass, with tubulature at bottom with ground in stopcock.

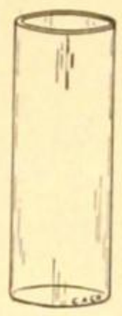
Cap., ounces ..	8		16		32
Each	**$3.25**		**3.50**		**3.75**
Cap., gallons..	½	1	2	3	5
Each	**$4.75**	**6.00**	**11.00**	**15.00**	**22.50**



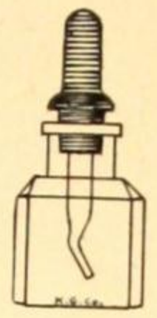
No. 157C.



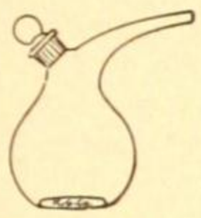
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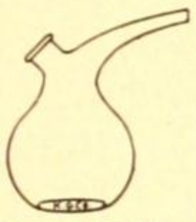
No. 161C.



No. 168C.



No. 170C.



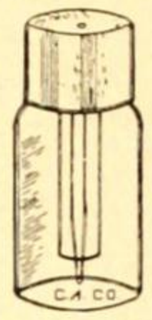
No. 175C.



No. 180C.



No. 185C.



No. 189C.

157C. Bottle, Balsam. With glass cap and loosely fitting dropper. Capacity, 30 cc..... **$0.40**

158C. Bottle, Balsam. With tightly fitting ground glass cap and glass rod. Capacity, 60 cc..... **$0.40**

161C. Bottles, Collecting. (Shell vials.) Best quality flint glass, round, straight wall, flat bottom.

Cat. No.	161C	162C	163C	164C	165C
Dimensions, mm.	50x12	60x13	70x15	80x16	75x25
Capacity, cc.	4	7	11	14	34
Per dozen	**$0.15**	.18	.24	.36	.60
Per gross	1.50	1.80	2.40	3.60	6.00

168C. Bottle, Dropping, Barnes. Glass, square, with combination stopper and pipette. Capacity, 30 cc. **$0.15**

170C. Bottle, Dropping. Schuster's, of flint glass, with ground-in glass stopper. Capacity, 30 cc.. **$0.40**

175C. Bottle, Dropping. Schuster's, of flint glass, without glass stopper. Capacity, 30 cc..... **$0.25**

180C. Bottles, Dropping, T. K. Glass, with projecting lug on vertical stopper to deliver contents drop by drop. Channel in stopper permits accurate control.

Capacity, cc.	30	60
Each	**$0.30**	.35

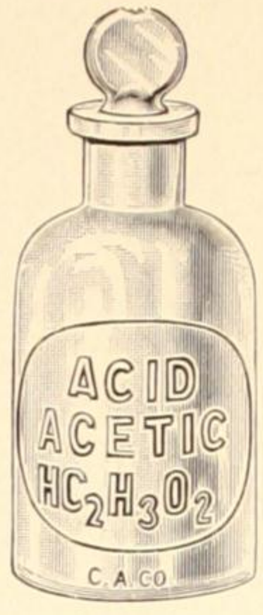
185C. Bottles, Homeopathic. (Vials.) Short form. Flint glass, machine made, uniform and well annealed. Dram = ⅛ ounce.

Cap., drams...	1	2	3	4	6	8
Height, mm...	42	58	64	68	80	83
Diameter, mm.	14	16	19	20	22	24
Per gross	**$1.80**	**2.00**	**2.75**	**4.00**	**5.00**	**6.50**

187C. Bottle, Immersion Oil. Provided with a ground cap and bone dropper. Its size is most handy and it has a very large foot so that it is not easily tipped **$0.75**

189C. Bottle, Immersion Oil. The bottle is of glass, a nickel-plated cap covers the neck of the bottle completely, resting on the body and preventing evaporation and consequent gumming. A plunger for taking up the oil is attached to the cap and is enclosed within the bottle in a tapered glass cylinder, open at the bottom. This cylinder enables one to regulate the amount of oil on the plunger before drawing it out of the neck of the bottle. A hole in the side of the cylinder at top provides an outlet for the purpose of cleaning the bottle. A quantity of immersion oil in a separate bottle is furnished with this immersion oil bottle **$1.85**

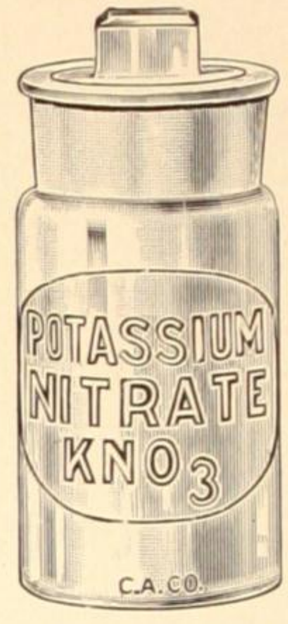
Reagent Bottles



No. 194C-3.



No. 194C-26.



No. 196C-302.



No. 196C-312.

With labels blown in the glass. The surface of each letter is ground to render it very distinct.
Made only in the sizes with labels listed below.
Please specify bottle number when ordering.

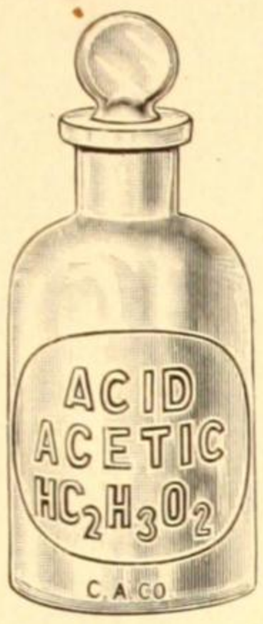
Note: Special bottles with labels other than listed can be furnished in the 4 oz. and 8 oz. sizes for $0.50 each higher than the prices given for regular stock bottles. In sizes larger than 8 oz. the charge is $1.00 each additional.

194C. Bottles, Reagent. Narrow mouth, 4 ounce, height 5¼ inches ..... **Per dozen $4.80**

Bottle No.		
3.	Acetic Acid	$HC^2H^3O^2$
30.	Alcohol	C^2H^5OH
77.	Ammonia	NH^3
18.	Ammonium Carbonate	$(NH^4)^2CO^3$
17.	Ammonium Chloride	NH^4CL
15.	Ammonium Hydroxide	NH^4OH
82.	Ammonium Molybdate	$(NH^4)^6Mo^7O^{24}$
19.	Ammonium Oxalate	$(NH^4)^2C^2O^4$
16.	Ammonium Sulphate (Amber)	$(NH^4)^2S$
31.	Ammonium Sulphocyanide	NH^4CNS
97.	Ammonium Sulphydrate	NH^4HS
33.	Barium Carbonate	$BaCO^3$
20.	Barium Chloride	$BaCL^2$
32.	Barium Hydroxide	$Ba(OH)^2$
401.	Barium Nitrate	$Ba(NO^3)^2$
38.	Blank (Without Label).	
426.	Bromine for Hypobromite.	
406.	Bromine Water.	
21.	Calcium Chloride	$CaCL^2$
23.	Calcium Hydroxide	$Ca(OH)^2$
22.	Calcium Sulphate	$CaSO^4$
83.	Carbon Disulphide	CS^2
407.	Chloroform	$CHCL^3$
408.	Cochineal.	
409.	Coralline.	
36.	Cupric Sulphate	$CuSo^4$
421.	Dimethyl Glyoxime	$(CH^3)^2C^2(NOH)^2$
35.	Ether	$(C^2H^5)^2O$
58.	Fehling's Solution.	
29.	Ferric Chloride	Fe^2CL^6
28.	Ferrous Sulphate	$FeSO^4$
2.	Hydrochloric Acid	HCL
419.	Hydrochloric Acid, Con.	HCL
429.	Hydrochloric Acid, Dil.	HCL
428.	Hydrogen Peroxide	H^2O^2
1.	Hydrogen Sulphide (Amber)	H^2S
87.	Indigo Solution.	
414.	Iodine Solution	$I+KI$
27.	Lead Acetate	$Pb(C^2H^3O^2)^2$
410.	Litmus.	
90.	Magnesia Mixture.	
24.	Magnesium Sulphate	$MgSO^4$
25.	Mercuric Chloride	$HgCL^2$
100.	Mercuric Potassium Iodide.	
86.	Mercurous Nitrate	$Hg(NO^3)^2$
415.	Methyl Alcohol	CH^3OH
411.	Methyl Orange.	
88.	Nessler's Solution.	
Bottle No.		
5.	Nitric Acid	HNO^3
422.	Nitric Acid, Con.	HNO^3
430.	Nitric Acid, Dil.	HNO^3
425.	Obermayer's Reagent.	
93.	Oxalic Acid	$H^2C^2O^4$
423.	Phenol	C^6H^5OH
412.	Phenolphthalein.	
94.	Picric Acid	$C^6H^2OH(NO^2)^3$
37.	Platinic Chloride	$PtCL^4$
8.	Potassium Carbonate	K^2CO^3
96.	Potassium Chromate	K^2CrO^4
13.	Potassium Dichromate	$K^2Cr^2O^7$
11.	Potassium Ferricyanide	$K^3Fe(CN)^6$
6.	Potassium Ferrocyanide	$K^4Fe(CN)^6$
12.	Potassium Hydroxide	KOH
10.	Potassium Iodide	KI
9.	Potassium Sulphate	K^2SO^4
7.	Potassium Sulphocyanide	$KCNS$
26.	Silver Nitrate (Amber)	$AgNo^3$
404.	Silver Sulphate	Ag^2SO^4
60.	Sodium Acetate	$NaC^2H^3O^2$
59.	Sodium Carbonate	Na^2CO^3
416.	Sodium Cobaltic Nitrite.	
61.	Sodium Hydroxide	$NaOH$
427.	Sodium Hydroxide for Hypobromite	$NaOH$
14.	Sodium Phosphate	Na^2HPO^4
417.	Sodium Thiosulphate	$Na^2S^2O^3$
81.	Stannous Chloride	$SnSL^2$
4.	Sulphuric Acid	H^2SO^4
420.	Sulphuric Acid, Con.	H^2SO^4
431.	Sulphuric Acid, Dil.	H^2SO^4
424.	Tinct. Guaiac.	
413.	Turmeric.	
38.	Without Label (Blank).	

196C. Bottles, Reagent. Wide mouth, 4 ounce, height 4⅞ inches ..... **Per dozen $5.50**

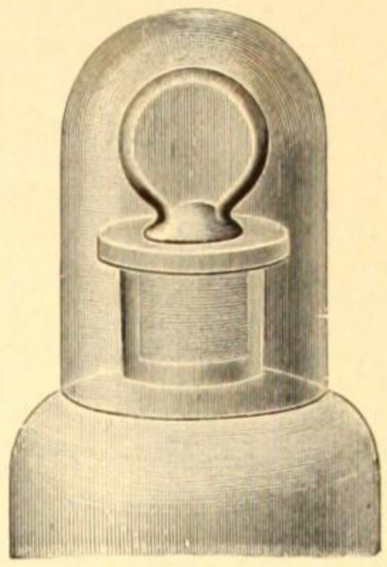
314.	Ammonium Sulphate	$(NH^4)^2SO^4$
307.	Blank (Without Label).	
304.	Borax	$Na^2B^4O^7$
305.	Ferrous Sulphate	$FeSO^4$
303.	Potassium Cyanide	KCN
302.	Potassium Nitrate	KNO^3
313.	Sodium Ammonium Hydrogen Phosphate	$Na(NH^4)HPO^4+H^2O$
301.	Sodium Carbonate	Na^2CO^3
312.	Test Paper.	
307.	Without Label (Blank).	



No. 198C-131.



No. 198C-145.



No. 210C.

198C. Bottles, Reagent. Narrow mouth, 8 ounce, height 6½ inches ..... **Per dozen $6.00**

Bottle No.

131. Acetic Acid ..... $HC^2H^3O^2$
126. Alcohol ..... C^2H^5OH
157. Ammonia ..... NH^2
110. Ammonium Carbonate ..... $(NH^4)^2CO^3$
109. Ammonium Chloride ..... NH^4CL
108. Ammonium Hydroxide ..... NH^4OH
155. Ammonium Molybdate ..... $(NH^4)^6Mo^7O^{24}$
130. Ammonium Oxalate ..... $(NH^4)^2C^2O^4$
158. Ammonium Phosphate ..... $(NH^4)^2HPO^4$
122. Ammonium Sulphide (Amber) . $(NH^4)^2S$
116. Blank (Without Label).
114. Barium Chloride ..... $BaCL^2$
151. Calcium Hydroxide ..... $Ca(OH)^2$
159. Ether ..... $(C^2H^5)^2O$
154. Ferrous Sulphate ..... $FeSO^4$
105. Hydrochloric Acid, Con. ..... HCL
106. Hydrochloric Acid, Dil. ..... HCL
107. Hydrogen Sulphide (Amber) .. H^2S
152. Lead Acetate ..... $Pb(C^2H^3O^2)^2$
153. Mercuric Chloride ..... $HgCL^2$
103. Nitric Acid, Con. ..... HNO^3
104. Nitric Acid, Dil. ..... HNO^3
171. Potassium Carbonate ..... K^2CO^3
160. Potassium Chromate ..... K^2CrO^4
172. Potassium Ferricyanide ..... $K^3Fe(CN)^6$
173. Potassium Ferrocyanide ..... $K^4Fe(CN)^6$
150. Potassium Hydroxide ..... KOH
145. Silver Nitrate (Amber) ..... $AgNO^3$
112. Sodium Carbonate ..... Na^2CO^3
111. Sodium Hydroxide ..... $NaOH$
129. Sodium Phosphate ..... Na^2HPO^4
156. Stannous Chloride ..... $SnCL^2$
101. Sulphuric Acid, Con. ..... H^2SO^4
102. Sulphuric Acid, Dil. ..... H^2SO^4
116. Without Label (Blank).

200C. Bottles, Reagent. Narrow mouth, 16 ounce, height 7¾ inches ..... **Per dozen $8.00**

237. Acetic Acid ..... $HC^2H^3O^2$
235. Ammonium Carbonate ..... $(NH^4)^2CO^3$
234. Ammonium Chloride ..... NH^4CL
204. Ammonium Hydroxide ..... NH^4OH
227. Ammonium Hydroxide, Dil.... NH^4OH+Aq
229. Ammonium Sulphide, Dil..... $(NH^4)^2S+Aq$
236. Ammonium Sulphide (Amber) . $(NH^4)^2S$
218. Barium Chloride ..... $BaCL^2$
211. Blank (Without Labels).
223. Calcium Hydroxide ..... $Ca(OH)^2$
225. Calcium Sulphate ..... $CaSO^4$
230. Ether ..... $(C^2H^5)^2O$

Bottle No.

224. Ferrous Sulphate ..... $FeSO^4$
217. Hydrochloric Acid ..... HCL
222. Hydrochloric Acid, Con. ..... HCL
231. Hydrochloric Acid, Dil. ..... HCL
226. Hydrodisodic Phosphate ..... Na^2HPO^4
216. Nitric Acid ..... HNO^3
219. Nitric Acid, Con. ..... HNO^3
232. Nitric Acid, Dil. ..... HNO^3
238. Potassium Chromate ..... K^2CrO^4
221. Potassium Hydroxide ..... KOH
233. Sodium Hydroxide ..... $NaOH$
228. Sodium Hydroxide, Dil. ..... $NaOH+Aq$
215. Sulphuric Acid ..... H^2SO^4
220. Sulphuric Acid, Con. ..... H^2SO^4
242. Sulphuric Acid, Dil. ..... H^2SO^4
211. Without Label (Blank).

202C. Bottles, Reagent. Narrow mouth, 32 ounce, height 9½ inches ..... **Per dozen $12.50**

511. Blank (Without Label).
505. Hydrochloric Acid, Con. ..... HCL
506. Hydrochloric Acid, Dil. ..... HCL
503. Nitric Acid, Con. ..... HNO^3
504. Nitric Acid, Dil. ..... HNO^3
501. Sulphuric Acid, Con. ..... H^2SO^4
502. Sulphuric Acid, Dil. ..... H^2SO^4
511. Without Label (Blank).

Reagent Bottles in Sets

204C. Bottles, Reagent, Set of. Set of 40 No. 194C Reagent Bottles, 4 ounce, including those most commonly used in the chemical laboratory. One each Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 59, 61 and three No. 40 Blanks (without labels) ..... **Per set $16.00**

206C. Bottles, Reagent, Set of. Set of 24 No. 194C Reagent Bottles, 4 ounce, according to Fresenius. One each Nos. 2, 3, 4, 5, 6, 7, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 25, 26, 27, 29, 32, 36, 59 and 61.
Per set **$9.60**

208C. Bottles, Reagent, Set of. Set of 12 No. 194C Reagent Bottles, 4 ounce. One each Nos. 1, 2, 3, 4, 5, 15, 16, 20, 23, 26, 27 and 61 ..... **Per set $4.80**

Reagent Bottle Caps

210C. Glass Dust Caps, for reagent bottles.

Cat. No.	210Ca	210Cb	210Cc	210Cd
For bottles of cap., oz.	4	8	16	32
Height, inside mm. ..	58	64	65	70
Diameter, inside, mm.	33	40	45	50
Per dozen	**$2.50**	**2.50**	**3.25**	**3.25**



No. 220C.



No. 225C.



No. 230C.



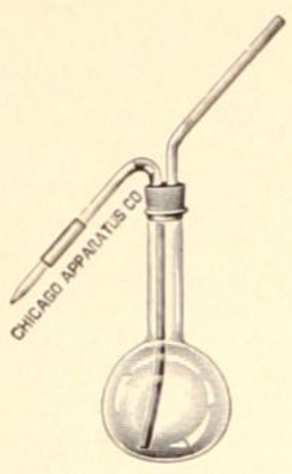
No. 235C.



No. 240C.



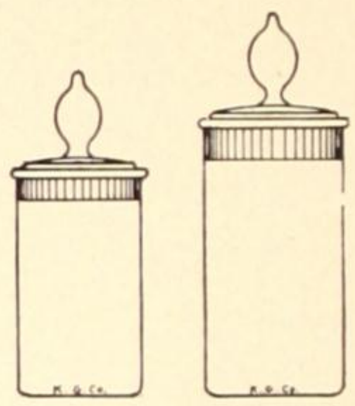
No. 242C.



No. 245C.



No. 250C.



No. 255C.



No. 265C.



No. 270C.

220C. Bottles, Screw Cap. (Vials.) Flint glass, with cork lined aluminum screw caps. Dram = ⅛ oz.

Capacity, drams	1	2	4	8	12
Diameter, inches	⅝	⅝	¾	⅞	⅞
Height, inches	1¾	2⅜	2⅝	3½	5½
Per dozen	**$0.36**	**.48**	**.66**	**1.08**	**1.44**

225C. Bottles, Specific Gravity. Accurately adjusted at 20 degrees C., flint glass with perforated stopper.

Cat. No.	225C	226C	227C	228C
Capacity, cc.	10	25	50	100
Each	**$0.80**	**1.00**	**1.25**	**1.60**

230C. Bottles, Specific Gravity. Unadjusted, for self-adjustment, flint glass, with perforated stopper.

Cat. No.	230C	231C	232C	233C
Capacity, cc.	10	25	50	100
Each	**$0.45**	**.50**	**.60**	**.70**

235C. Bottles, Specimen, Round. Of flint glass, with cork-lined metal screw caps.

Capacity, ounces	1	2	4	8
Height, inches	3⅛	3¾	4¾	4 11/16
Diameter, inches	1⅛	1½	1⅞	2½
Per dozen	**$1.25**	**1.30**	**1.75**	**2.25**

240C. Bottles, Specimen, Square. Of flint glass, with cork-lined metal screw caps.

Capacity, ounces	1	2	4	8
Height, inches	2½	2 13/32	4½	5 9/16
Side, inches	1⅜	1½	1 13/16	2⅛
Per dozen	**$1.25**	**1.35**	**1.75**	**2.10**

242C. Bottles, Inverted Specimen. For exhibiting ore, mineral and chemical samples.

Capacity, pints	⅛	¼	½	1	2	4
Height, inches	3⅞	4⅝	6¼	8	9¼	11
Diam., inches	1½	2	2½	2¾	3⅝	4¼
Each	**$0.30**	**.38**	**.45**	**.60**	**.75**	**1.25**

245C. Bottles, Washing. Fitted with rubber stopper and movable delivery tube.

Capacity, cc.	250	500	1000
Each	**$0.50**	**.85**	**1.10**

250C. Bottles, Washing. Made entirely of glass, with ground connections, for ether.

Capacity, cc.	250	500
Each	**$1.35**	**1.60**

255C. Bottles, Weighing. High form, flint glass, flat bottom with ground-in glass stopper.

Cat. No.	255C	256C
Height, mm.	65	100
Diameter, mm.	15	25
Each	**$0.50**	**.75**

260C. Bottles, Weighing. Low form, flint glass, flat bottom, without neck, with ground glass stopper. Three last sizes are extra wide form.

Height, mm.	40	50	50	60
Diameter, mm.	25	25	40	30
Each	**$0.40**	**.45**	**.65**	**.50**
Height, mm.	80	30	30	30
Diameter, mm.	40	50	60	70
Each	**$0.70**	**1.10**	**1.50**	**2.10**

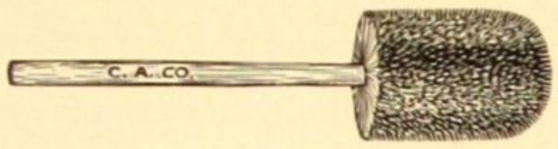
265C. Bottles, Woulff's. Heavy flint glass, with two necks.

Capacity, cc.	125	250	500	1000
Each	**$1.00**	**1.20**	**1.50**	**1.90**

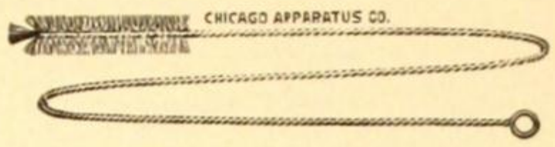
270C. Bottles, Woulff's. Heavy flint glass, with three necks.

Capacity, cc.	125	250	500	1000
Each	**$1.25**	**1.35**	**1.65**	**2.00**

BRUSHES



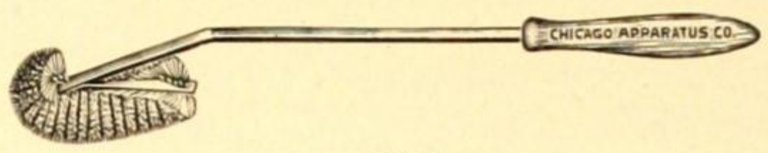
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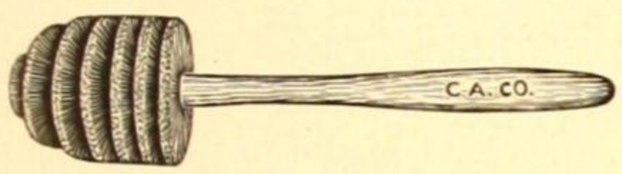
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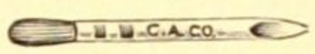
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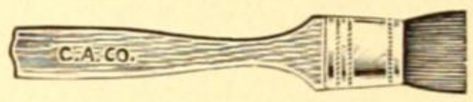
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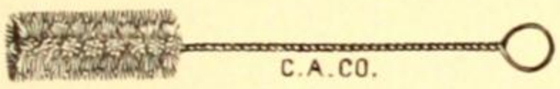
No. 305C.



No. 310C.



No. 315C.



No. 319C.



Nos. 320C-325C.

*275C. **Brush, Beaker.** Black bristles, wood handle. Length of bristle part, 5 inches; diameter, 2½ inches; total length 17 inches **$0.25**

*280C. **Brush, Burette.** For 10 and 25 cc. burettes. White bristles, tinned wire handle. Length of bristle part, 3 inches; diameter, ½ inch; total length, 24 inches **$0.15**

*285C. **Brush, Burette.** For 50 and 100 cc. burettes. White bristles, tinned wire handles. Length of bristle part, 4½ inches; diameter, 1 inch; total length, 36 inches **$0.20**

*290C. **Brush, Counter.** (Dusting brush.) Wooden handle, black bristles. Length of bristle part, 8 inches; width, 2½ inches; total length, 14 inches **$0.65**

*300C. **Brush, Flask.** For cleaning Erlenmeyer and volumetric flasks. The bristle part is attached to a flexible spring, thus enabling the brush to reach every part of the flask.

Cat. No.	300C	301C	302C
For flasks of capacity, cc.	250	500	1000
Each	**$0.35**	**.40**	**.45**

*305C. **Brush, Funnel, Jar and Cylinder.** Wooden handle, black bristles, taper end. Length of bristle part, 3 inches; diameter at large end, 2¾ inches; length, 11 inches **$0.45**

310C. **Brush, Pencil.** Of camel's hair bound in quill handles.

Cat. No.	310C	311C	312C
Size	Small	Medium	Large
Per dozen	**$0.15**	**.30**	**.40**

*313C. **Brush, Pipette,** for cleaning volumetric, Mohr's or milk pipettes. Length of bristle part, 7 inches; total length, 16 inches **$0.15**

*315C. **Brush, Scale Pan.** Camel's hair, wooden handle, metal bound.

Cat. No.	315C	316C	317C	318C
Width of hair part, inches	½	1	1½	2
Each	**$0.20**	**.25**	**.35**	**.45**

319C. **Brush, Test Tube.** Tinned wire; length of bristle part, 3½ inches; diameter, 1 inch; total length, 10 inches.

Each	**$0.06**
Per dozen	**.60**
Per gross	**6.50**

320C. **Brush, Test Tube, Bristle End.** Brass wire. Length of bristle part over all, 4 inches; diameter, 1½ inches; total length, 10 inches.

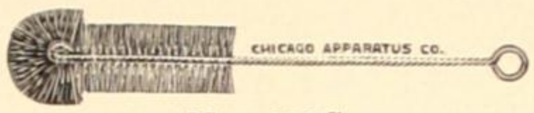
Each	**$ 0.10**
Per dozen	**1.10**
Per gross	**10.80**

325C. **Brush, Test Tube, Bristle End.** Same as No. 320C, but with tinned wire.

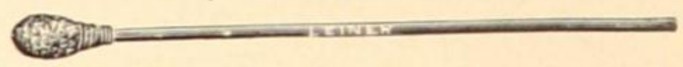
Each	**$0.08**
Per dozen	**.80**
Per gross	**8.65**

*10% discount in lots of 12.

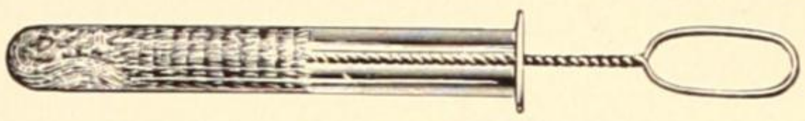
Brushes—Cont.



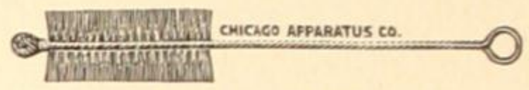
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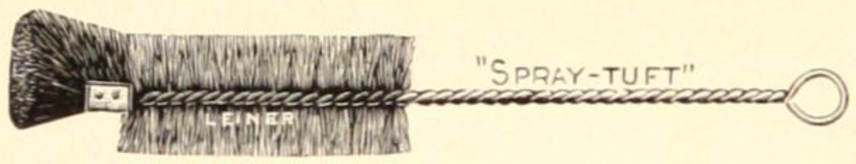
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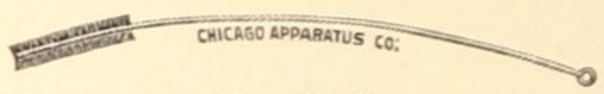
Nos. 335C-340C.



Nos. 345C-350C.



No. 355C.



No. 360C.

330C. Brush, Test Tube, End Tuft. A very superior brush—better than the ordinary bristle end brush. Length of bristle part, 3½ inches; diameter, 1 inch; total length, 10 inches. Tinned wire handle.

Each	$0.09
Per dozen	.90
Per gross	9.75

331C. Brush, Test Tube, Fan Tip. For tubes ¾ to 1 inch in diameter. Made from French bristles, selected 2½ inches long before cutting. In this brush 25 per cent more bristles are used than in the average test tube brush. Bristles are closely bound 5 to 6 turns to the inch, producing a fan-shaped tip and a uniform scrubbing surface. The handle is galvanized, twisted No. 15 B. & S. gauge wire. Length of bristle part, 3½ inches; diameter, 1¼ inches; total length, 9½ inches.

Each	$ 0.10
Per dozen	1.00
Per gross	10.80

332C. Brush, Test Tube, Fan Tip. For tubes ½ to ⅝ inch diameter. Same as No. 331C, but for smaller test tubes. Length of bristle part, 3 inches; diameter, ¾ inch; total length, 10 inches.

Each	$ 0.10
Per dozen	1.00
Per gross	10.80

333C. Brush, Test Tube (Probangs). Sponge end, rattan handle 9 in. long.

Each	$ 0.17
Per dozen	1.70
Per gross	18.00

335C. Brush, Test Tube, Side Tuft. Touches every part of the inside of the test tube. All bristles are twisted on one stem and cannot come out. Tinned wire, white bristles; length of bristle part over all, 4 inches; diameter, 1⅛ inches; total length, 10½ inches. For tubes up to ¾ inch in diameter.

Each	$ 0.11
Per dozen	1.10
Per gross	11.85

340C. Brush, Test Tube, Side Tuft. Same as No. 335C, but larger. Tinned wire, white bristles; length of bristle part over all, 5 inches; diameter, 1⅞ inches; total length, 13½ inches. For tubes up to 1¼ inches in diameter.

Each	$ 0.13
Per dozen	1.30
Per gross	14.00

345C. Brush, Test Tube. Sponge End. Brass wire. Length of bristle part, including sponge, 3 inches; diameter, 1½ inches; total length, 9½ inches.

Each	$ 0.12
Per dozen	1.20
Per gross	12.95

350C. Brush, Test Tube. Sponge End. Same as No. 345C, but with tinned wire.

Each	$0.08
Per dozen	.80
Per gross	8.65

355C. Brush, Test Tube, Spray Tuft. The latest and most efficient brush for cleaning test tubes and bottles. Reaches all parts of the tube. No metal can touch the glass, therefore no broken test tubes. Tinned wire handle; bristle part over all, 4½ inches; diameter, 1⅜ inches; total length, 10 inches.

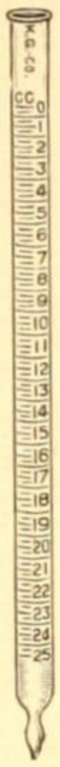
Each	$ 0.12
Per dozen	1.20
Per gross	12.95

360C. Brush, Tube. For cleaning small tubes, funnel stems, etc. Length of bristle part, 2 inches; diameter, ½ inch; total length, 12½ inches.

Per dozen	$0.45



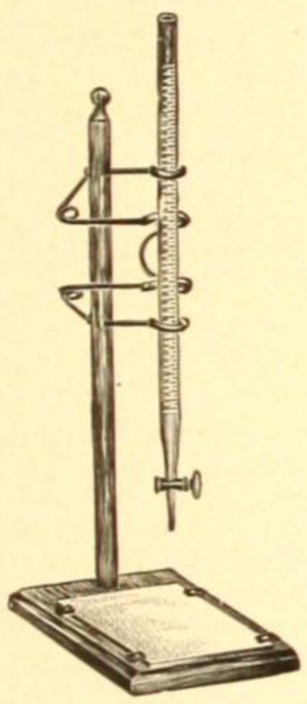
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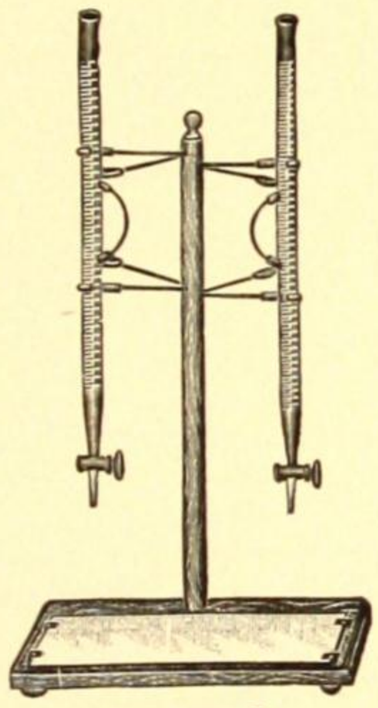
No. 365C.



No. 370C.



No. 389C.



No. 390C.



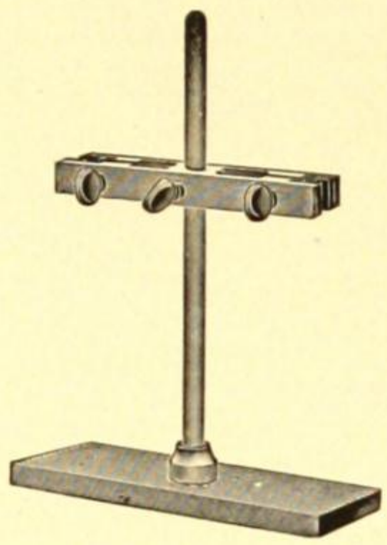
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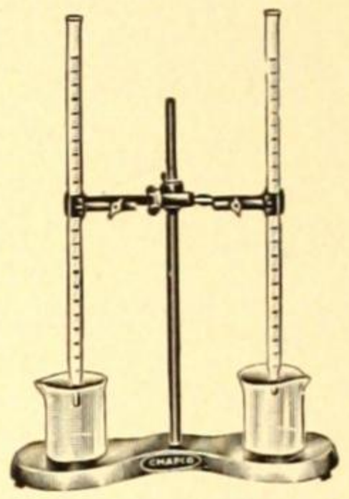
No. 380C.



No. 385C.



No. 400C.



No. 405C.

362C. **Bulb, Leveling.** Glass, used in gas analysis work, etc. Capacity 250 cc. **$0.75**

Burettes and Supports

***365C. Burettes.** For pinchcock, without fittings; 25 cc. and 50 cc. graduated in $\frac{1}{10}$ cc.—100 cc. graduated in 1/5 cc.

Cat. No.	365C	366C	367C
Capacity, cc.	25	50	100
Each	**$0.65**	**.90**	**1.10**

***370C. Burettes.** With straight glass stopcock; 25 cc. and 50 cc. graduated in 1/10 cc.—100 cc. graduated in 1/5 cc.

Cat. No.	370C	371C	372C
Capacity, cc.	25	50	100
Each	**$1.50**	**1.75**	**2.25**

***373C. Burette, Schellbach.** For Pinchcock. With dark enameled stripe on white enameled background, giving a definite meniscus; 25 cc. and 50 cc. graduated in 1/10 cc.—100 cc. graduated in 1/5 cc.

Capacity, cc.	25	50	100
Each	**$1.30**	**1.75**	**2.50**

***374C. Burette, Schellbach.** With straight stopcock. Otherwise the same as No. 373C; 25 cc. and 50 cc. graduated in 1/10 cc.—100 cc. graduated in 1/5 cc.

Capacity, cc.	25	50	100
Each	**$1.75**	**2.50**	**3.25**

***375C. Burette Attachment.** For use with Nos. 365C-367C Burettes. Glass tip, rubber tube and pinchcock **$0.30**

***380C. Burette Float, Erdman's.** Glass, with points to prevent adherence to side of burettes.....**$0.60**

***385C. Burette Funnel.** A small glass funnel for use in filling burettes **$0.25**

***389C. Burette Support, Chaddock's.** With rubber-lined wire clamps for holding the burette, which is readily placed in position or removed by simply springing back the wire. Rod and base of wood and a piece of opal glass is fastened on base. For one burette. **$2.25**

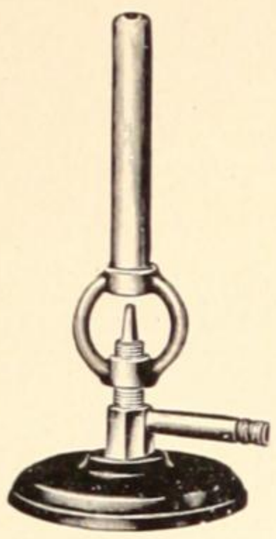
***390C. Burette Support, Chaddock's.** Same as No. 389C, but for two burettes **$3.25**

***400C. Burette Support, Hardwood.** Same as No. 390C, but for two burettes.....**$1.80**

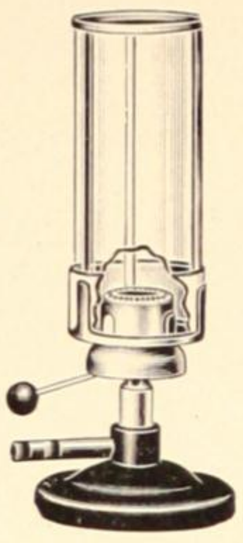
***405C. Burette Support, Iron.** Japanned base, coppered steel rod 20 inches long, and No. 640C Double Burette Clamp. Without burettes or beakers...**$2.00**

***10% discount in lots of 12—20% discount in lots of 48.**

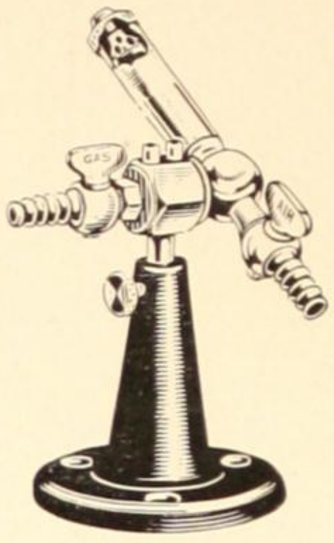
Burners of All Kinds



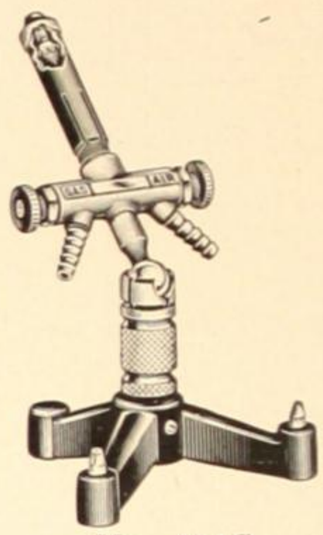
No. 412C.



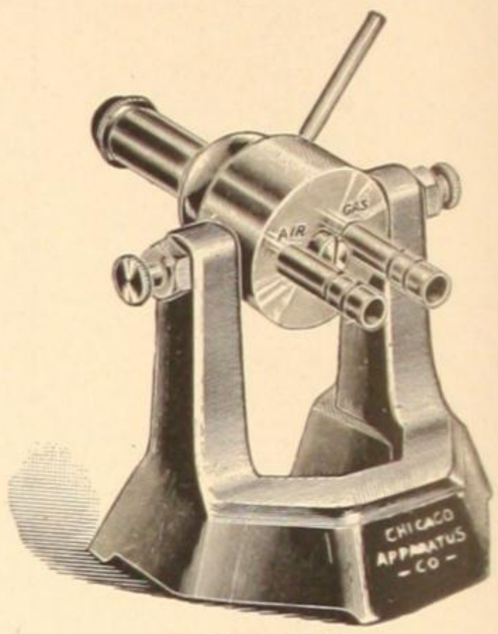
No. 414C.



No. 415C.



No. 416C.



No. 420C.

For Acetylene Gas

412C. Burner, Bunsen. Especially designed for acetylene gas. Height of burner, 5½ inches, diameter of tube $\frac{9}{16}$ in. **$2.00**

For Coal Gas

414C. Burner, Argand, with Glass Chimney. For use where constant, low and medium heats are required. Improved design of rugged construction. Gas orifices are arranged in a circle and air is supplied to the center as well as to the outer surface of the flame. The chimney serves as a flame guard. The flame produces a steady heat and is adjustable for size. On enameled iron base. For use on artificial gas. Overall height, 220 mm. **$2.00**

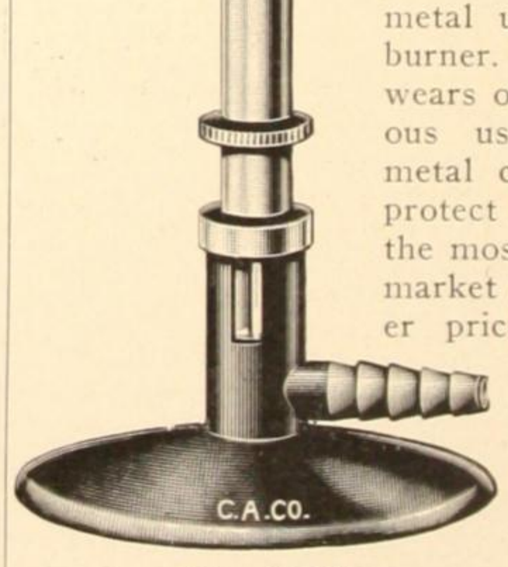
415C. Burner, Blast, Bunsen's. Provided with three tips for various gases. Has separate stopcocks for gas and air. Easily adjustable so flame may be directed at different angles. Heavy iron enameled base with screw holes. Tube is 18 mm. diameter and has movable sleeve. Can be regulated to a fine pointed flame. A good burner for glass-blowing **$4.00**

416C. Burner, Blast, Mass. Inst. of Tech. Pattern. The ball and socket joint mounting permit flame to be directed at any angle. Also makes burner readily detachable for use as hand blowpipe. Gas and air regulation is by needle valves. Tube is 20 mm. in diameter and has movable sleeve. With three tips for various gases **$6.25**

420C. Burner, Blast. Fletcher's Compound. This is a double concentric blast lamp with an inner air jet and a middle tube which may be used either for air or gas, and an external gas tube. The gas and air are changed automatically from the larger to the smaller tubes by a slight movement of the lever at the back. The same movement also adjusts both gas and air to each other for each tube. The combination of two blowpipes in this manner gives a greater range—from a delicate pointed jet to a large brush flame. Provided with pilot light. Approximate gas consumption per hour, small flame, 30 cubic feet; large flame, 54 cubic feet. For best results, Foot Blowers Nos. 82C or 85C should be used..... **$12.50**

426C. Bunsen Burner, New Milvay, with chrome base. This new exclusive **Milvay** design offers advantages unobtainable in any other Bunsen Burner. Because of the one piece die-cast base (made of non-corrodible alloy) there is no possibility of leaks. The air chamber and gas inlet tube are a part of the base. Hose connection is serrated and tapered, giving a non-slip tubing connection that will take tubing of $\frac{3}{16}$, ¼, ½-inch diameter. This burner has the largest mixing chamber of any offered. Air control is by means of a one-seventh turn of the knurled finger grip on the tube, which gives complete regulation from a blue to yellow flame. This construction offers two advantages. 1—Fingers do not obstruct air passages while regulating. 2—So precisely made that air may be completely shut off, giving an entirely yellow flame.

There are no screw connections in the burner to stick or bind, assuring an even and lasting, smooth regulation. There is no steel, iron, or other corrodible metal used in any part of the burner. When the original finish wears off after long and continuous usage, the non-corrodible metal construction continues to protect the burner. And withal, the most beautiful burner on the market at ordinary Bunsen Burner prices. Overall height, 135 mm., extra large base giving unusual stability, 75 mm. diameter. Diameter of Burner Tube, $\frac{7}{16}$ inch.

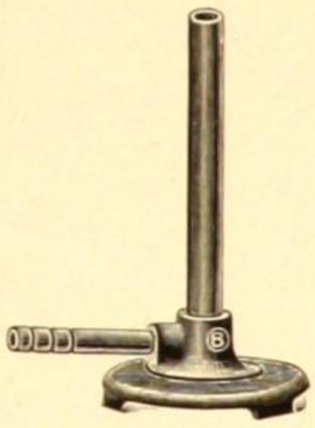


No. 426C.
Milvay Bunsen Burner
New Design

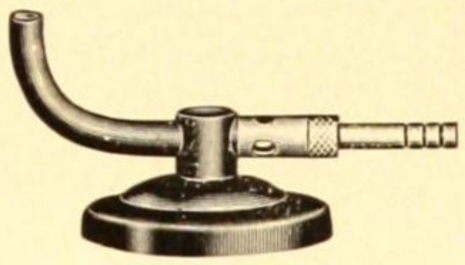
Each **$0.35**
Per dozen **3.50**
Per hundred **25.00**



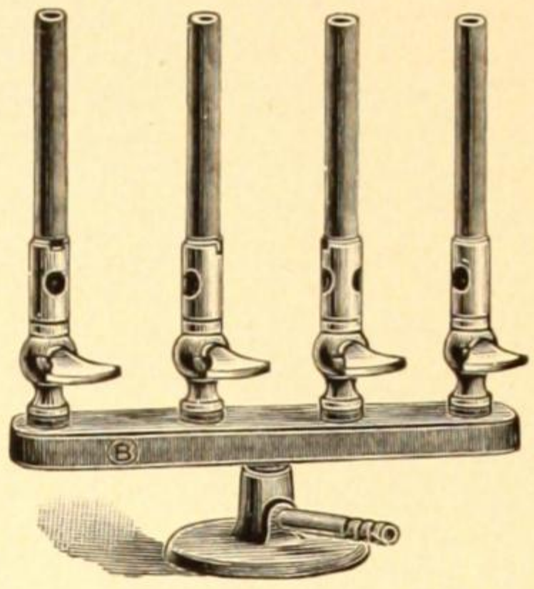
No. 428C.



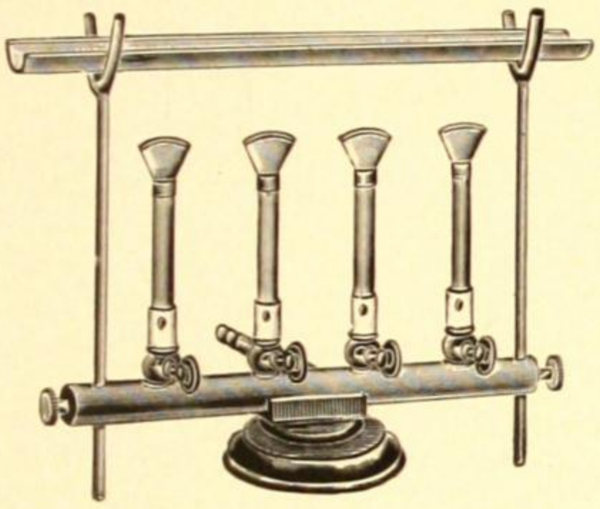
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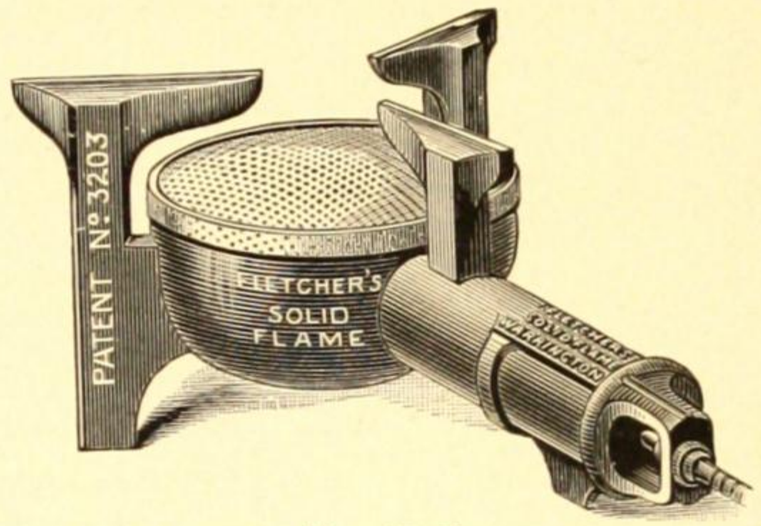
No. 442C.



No. 470C.



No. 475C.



No. 480C.

For Coal Gas (Continued)

428C. Burner, Bunsen, with Pilot. For coal or artificial gas. Has set screw for regulating size of pilot flame and stopcock for turning on and shutting off the gas supply to the burner tube. Height, 5¾ inches; diameter of burner tube, ½ inch.....**$1.50**

435C. Burner, Bunsen. Center Draft. With air regulator. Ideal for students' use. Substances accidentally dropped into burner tube will fall clear through. No tip to clog. Oxidized brass burner tube, $\frac{7}{16}$ inch diameter, brass inlet tube, japanned iron base. Height, 5¾ inches.

Each	**$ 0.45**
Per dozen	**4.50**

442C. Burner, Bunsen. Low form. With air regulator. Height, 3 inches; diameter of tube, $\frac{7}{16}$ inch.

Each	**$0.60**
Per dozen	**6.00**

470C. Burner, Multiple Tube. With four tubes in one row, each with stopcock. Height, 7¾ inches...**$5.00**

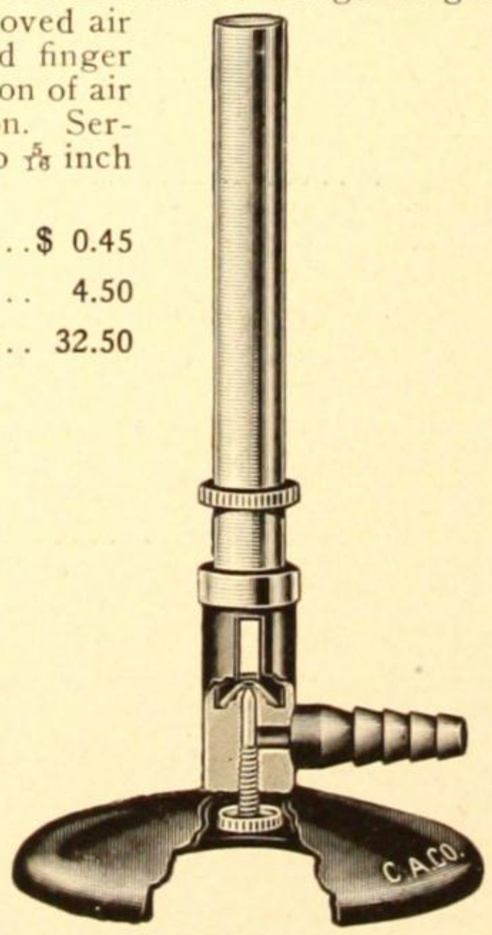
475C. Burner, Multiple Tube. Simple combustion furnace. Four burners in one row, each with stopcock and wing top, complete with adjustable forks for holding combustion tubes.....**$7.50**

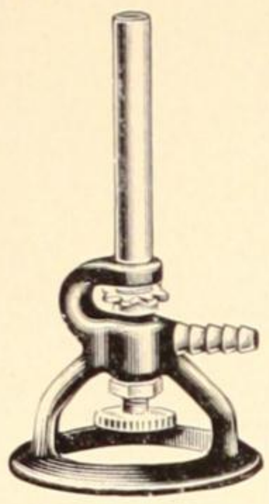
480C. Burner, Solid Flame, Fletcher's. For quick heating. Will quickly boil four or five gallons of water and will, when required, keep a small amount of water boiling steadily by simply turning the gas low. Maximum gas consumption 50 cubic feet per hour. Diameter of flame surface, 3¼ inches....**$3.25**

For Coal, Natural or Gasoline Gas

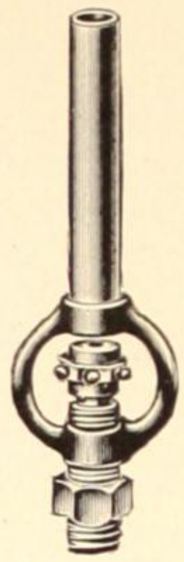
485C. Burner, Bunsen-Milvay. A low-cost efficient burner, with adjustments for both gas and air. Die-cast base, finished in chrome enamel. Large air-gas mixing chamber. Improved air regulator with knurled finger grip prevents obstruction of air flow during regulation. Serrated gas inlet for $\frac{3}{16}$ to $\frac{5}{16}$ inch bore tubing.

Each	**$ 0.45**
Per dozen	**4.50**
Per hundred	**32.50**

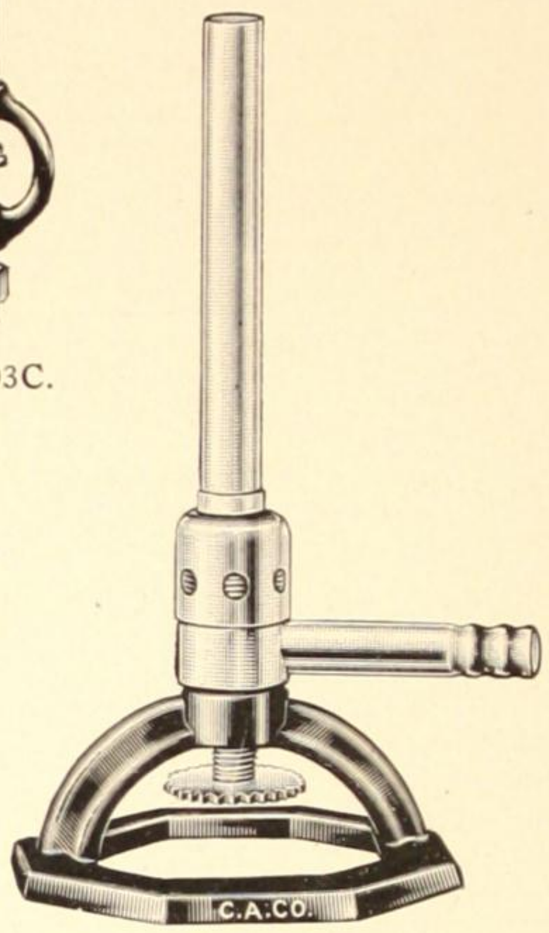




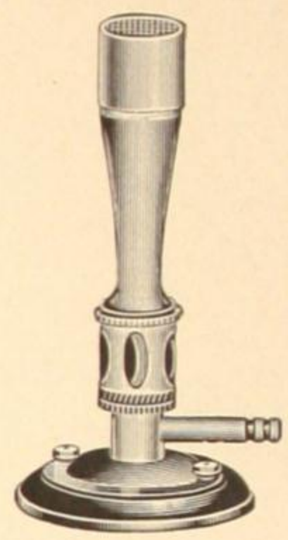
No. 490C.



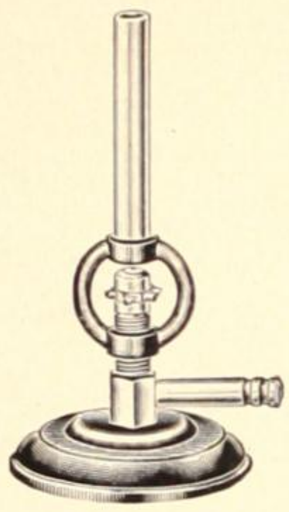
No. 493C.



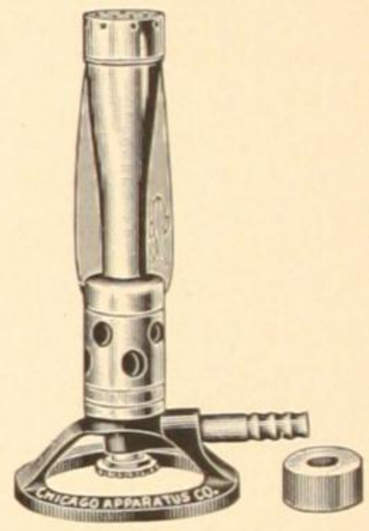
No. 495C.



No. 498C.



No. 492C.



No. 497C.

For Coal, Natural or Gasoline Gas—Cont.

*490C. **Burner, Boyce's Adjustable.** Improved regulator for air and gas. Stationary burner tube permits all attachments to be used to advantage. For coal, gasoline or natural gas. Diameter of tube, $\frac{7}{8}$ inch $0.75

*492C. **Burner, Fletcher.** Has regulators for gas and air; burns gasoline gas, coal gas or natural gas; diameter of brass tube, 13 mm.; overall height, 165 mm.; enameled iron base $1.35

*493C. **Burner, Fletcher, without Base.** Like No. 492C, but for screwing directly into the gas supply line as in Kjeldahl Digesting Shelves or where permanently connected burners are desired. The lower end with $\frac{1}{8}$ inch I. P. thread measures $\frac{3}{8}$ inch in diameter $1.10

*495C. **Burner, Milvay.** Guaranteed to work on any kind of gas—city coal gas, natural, or gasoline gas. Will not flash back, clog or sing. Produces a blue flame of maximum temperature. Air and gas are controlled independently. Flame can be varied from large and powerful to very small, and whether large or small it may be sharply concentrated. Constructed of brass throughout, except the base, which is iron and nicely japanned. Height, 6½ inches. The most efficient, economical and reliable burner for all general laboratory work. Diameter of burner tub, $\frac{7}{8}$ inch $1.00

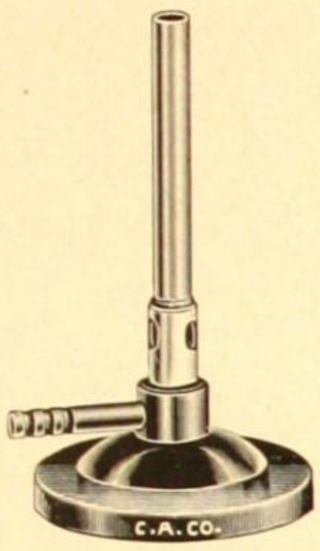
High Temperature Burners

497C. **Burners, High Temperature, Fisher's.** A Meker type burner, produced in large quantities by special machinery, making possible a price far below the true worth of this article. The perforated nickel cap produces a Meker flame, the brass cap with hole the usual Bunsen flame. For coal or gasoline gas. Height, 7¼ inches; diameter of tube, 1⅛ inches.
Each ..... $ 2.00
Per hundred 190.00

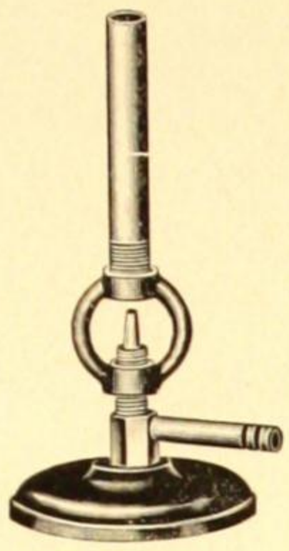
498C. **Burner, High Temperature, Meker's.** For coal gas, gasoline gas, and natural gas. In this type of burner the fuel passes through a deep metallic mesh or grid of nickel, just before it issues from the burner tube. As a result the fuel is preheated and burns with an intensely hot flame—much hotter than that produced by ordinary burners. Three interchangeable gas orifices are supplied, the two extra ones being screwed into the base where they will be available when needed. Made in three sizes. No. 1 is recommended for sealing, Nos. 2 and 3 for general laboratory work, and No. 4 as a substitute for blast burners and for heating furnaces, etc.

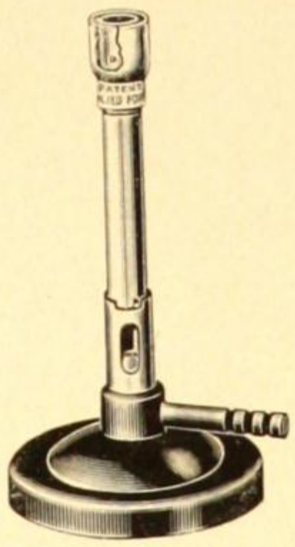
Size No.	2	3	4
Total height, mm.	130	155	190
Diameter of top, mm.	20	24	30
Each	$2.10	2.50	3.00

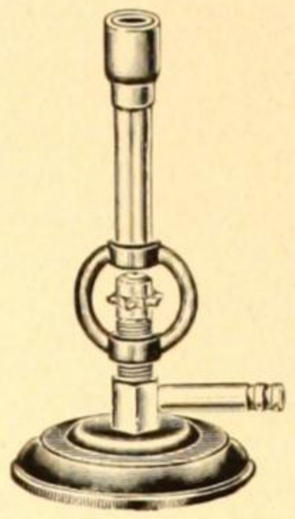
*10% Discount in lots of one dozen.



No. 499C.


No. 499Ca.


No. 501C.

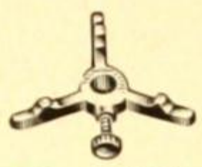

Nos. 502C-503C.


No. 500C.


No. 505C.


No. 510C.


No. 512C.


No. 515C.


No. 520C.


No. 522C.


No. 525C.

For Cylinder Gas and Natural Gas

499C. Burner, Pyrofax. A standard low-priced Bunsen-type burner with special orifice for Pyrofax gas. Burner tube, $\frac{7}{16}$ inch diameter; hose connection, $\frac{7}{16}$ inch diameter; base, 3 inches diameter; overall height, 5¼ inches. Brass burner tube, enameled base, nickel-plated air regulator **$0.50**

499Ca. Burner, Pyrofax, Adjustable. This burner will give better satisfaction under all conditions than the non-adjustable type. Furthermore it will burn Blau as well as Pyrofax gas. Burner tube is ½-inch diameter and the overall height, 6½ inches.... **$1.25**

501C. Burner, Natural Gas. P. G. & E. Type. (Patent Applied for). Developed in the Bureau of Tests and Inspection of the Pacific Gas and Electric Company. It is the only low-priced burner so far available that will give entirely satisfactory results with Natural Gas. It differs from the ordinary natural gas burner in that it is fitted with a special tip which acts as a pilot flame, constantly keeping the main flame alive and preventing it from blowing off the tip as is the tendency with gases high in B.T.U. value. This fault of the flame leaving the burner tube has been definitely overcome by the introduction of the tip described and illustrated above. Burner tube, of brass, ½-inch diameter; outside diameter of tip, $\frac{11}{16}$ inches, enameled stamped metal base, 3 inches in diameter; overall height, 6 inches **$0.75**

502C. Burner, Fletcher, Adjustable, P. G. & E. Type. (Patent Applied for). For Natural Gas. This burner operates on the same principle as No. 501C. However, it is provided with adjustments for both gas and air so that the size of the flame can be varied and adjustments made to suit varying conditions of gas pressure. This is the best and most dependable burner now available for use with Natural Gas. Brass burner tube, ½ inch diameter; outside diameter of tip, $\frac{11}{16}$ inch; enameled metal base, 3 inches in diameter; overall height, 6 inches..... **$2.10**

503C. Burner, Fletcher, Adjustable, P. G. & E. Type. (Patent Applied for). For Cylinder Gases, such as Flamo, Shellane, Rockgas, Pyrofax, Stargas, Philgas, Skelgas, Nugas, and others. Same in all details as No. 502C, except the gas orifice is necessarily somewhat smaller **$2.10**

Burner Attachments and Accessories

500C. Burner Blowpipe Tip. Fits outside $\frac{7}{16}$-inch burner tube with rest for blowpipe **$0.20**

505C. Burner Blowpipe Tube. For producing yellow flame, fits inside $\frac{7}{16}$-inch burner tube, with rest for blowpipe **$0.22**

510C. Burner Chimney. Russia iron, to protect flame from drafts, for use with No. 515C support. Height, 2 inches; top diameter, 2 inches; bottom diameter, 1½ inches **$0.15**

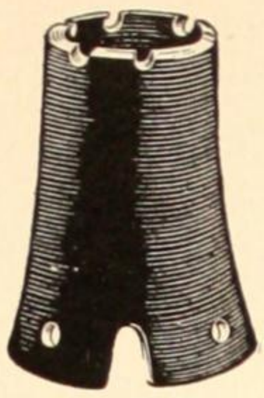
512C. Burner Chimney with Support. Similar to No. 510C, but with bracket and set screw for attaching at any suitable height on the burner. For burner having burner tubes $\frac{7}{16}$ inches in diameter..... **$0.70**

515C. Burner Chimney Support. For supporting No. 510C chimney. Fits burner tube $\frac{7}{16}$ inch in diameter **$0.25**

520C. Burner Crown Top. Diameter, 1 inch; fits burner tube $\frac{7}{16}$ inch in diameter. Gives a large, round flame on heating dishes **$0.50**

522C. Burner Flame Spreader. Serves two purposes—it spreads the flame and prevents it from striking back. Fits any burner with $\frac{7}{16}$ inch burner tube. Either our No. 485C or No. 490C Burner with separate air and gas regulation, when equipped with this attachment, will burn fuel containing a greater admixture of air, resulting in a noticeably hotter flame **$0.25**

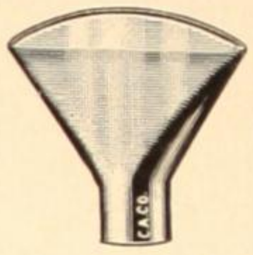
525C. Burner Gauze Top. Diameter, 1½ inches; fits burner tube $\frac{7}{16}$ inch diameter. Gives a large round flame for heating dishes, etc. **$0.35**



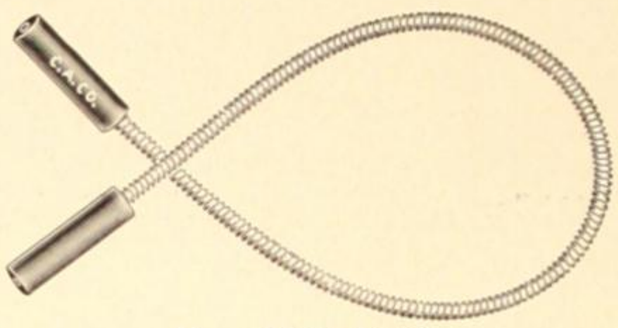
No. 527C.



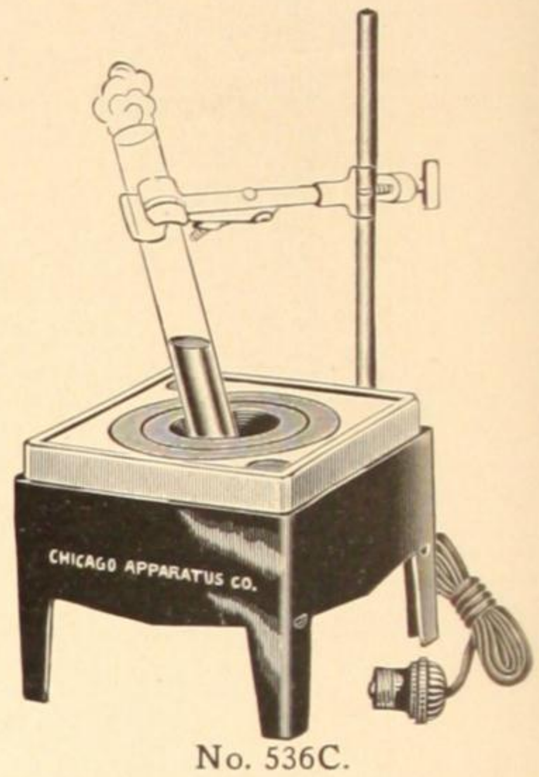
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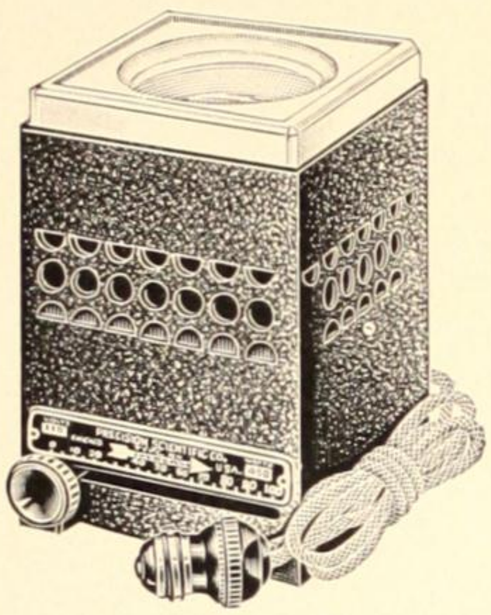
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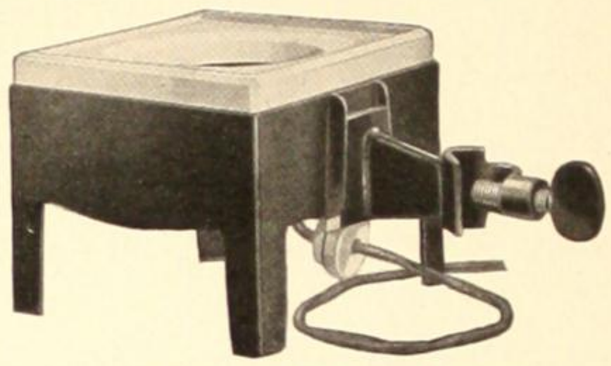
Nos. 532C-534C.



No. 536C.



No. 6015C.



Nos. 6005C-6010C.



No. 6020C.

Burner Accessories—Cont.

527C. Burner Guard, Earthenware. Protects flame from drafts and is also a rigid and convenient support. Height, 9 inches; base diameter, 8 inches; top diameter, 5 inches. Has holes for rubber tubing and air **$0.75**

530C. Burner Tripod. For holding dishes 3 inches or more in diameter. Fits burner tube $\frac{7}{16}$ inch diameter **$0.25**

532C. Burner Tubing. Flexible steel, with rubber packing. For conveying gas to Bunsen burners, hotplates, etc. Gas tight and proof against kinking and breaking. With heavy rubber socket at each end. Inside diameter, ¼ inch; length, 24 inches **$0.30**

533C. Burner Tubing. Same as No. 532C, but 36 inches long **$0.45**

534C. Burner Tubing. Same as No. 532C, but 60 inches long **$0.75**

535C. Burner, Wingtop. Fits any burner with $\frac{7}{16}$-inch burner tube. Useful in bending glass tubing.
Each **$0.12**
Per hundred **9.00**

Electric Burners

536C. Heater, Electric, Laboratory. Suitable for nearly every laboratory use—heating the contents of flasks, beakers, test tubes, evaporating dishes, retorts, water baths, crucibles, steam generators, etc. Has efficient long-life chromel heating unit that develops 1800° F, and will bring 500 cc. of water to a boil in 12 minutes. Has support rod, which can be removed when desired, for holding clamps and rings for supporting test tubes, retorts and other glassware in the most desirable position. The top opening of 75 mm. is suitable for flasks and beakers, while the two concentric rings provide the smaller openings for dishes and crucibles. Case is of Armco steel, finished in black enamel and provided with four legs. The cord has a two-piece plug and will fit any socket or outlet. Consumes 550 watts. Operates on 110-volt A.C. or D.C. current. Complete, as illustrated, but without clamp and test tube **$7.50**

6005C. Heater, Electric, Laboratory. Same as No. 536C, but without support rod, heater clamp, burette clamp, test tube, and concentric rings **$6.00**

6010C. Heater Clamp. Fits into bracket of heater as shown in illustration Nos. 6005C-6010C. Useful in supporting the entire heater at an elevation on an apparatus stand or for holding a support rod in a vertical position as shown in illustration No. 536C **$0.90**

6015C. Heater, Electric, with Rheostat Control. Proper heat for any particular operation is quickly secured by turning the knob projecting through the front of the case. The same setting on the graduated scale always gives the same heat.

Opening in the top refractory is 75 mm. in diameter and accommodates both the 500 cc. and 800 cc. Kjeldahl flasks. Heating element is the long-life chromel type and develops 1800° F. At the rear of the case is a removable clamp like that shown in illustration Nos. 6005C-6010C for clamping the entire heater at an elevation on an apparatus stand. The heater proper is 5x5x7 inches high. Its maximum current draw is 5 amperes. The metal case is finished in crystal black. Cord has two-piece plug fitting any socket or outlet.

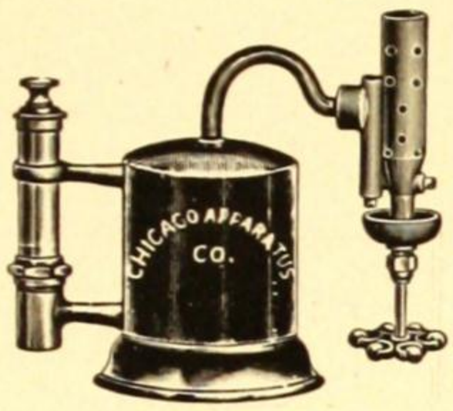
Operates on 110 volts A.C. or D.C. current... **$15.00**

6020C. Heating Unit. For replacement in Heaters Nos. 536C, 6005C, and 6015C. Long-life, 110-volt chromel type. Can be quickly and easily installed **$1.00**

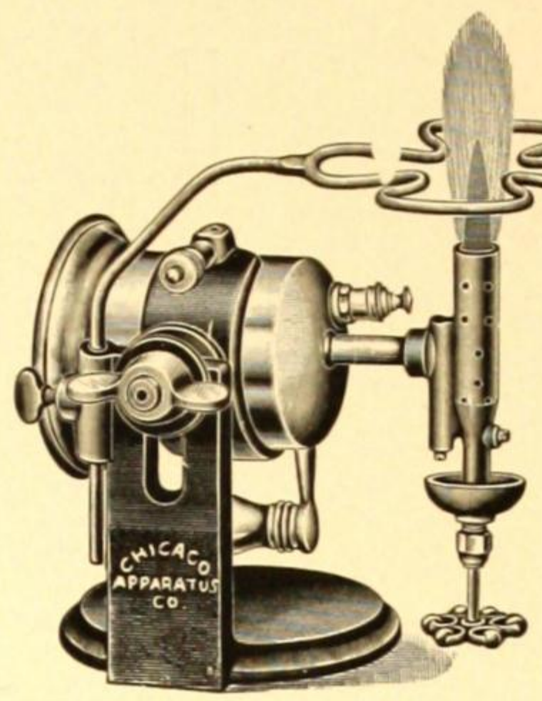
BURNERS FOR LIQUID GASOLINE



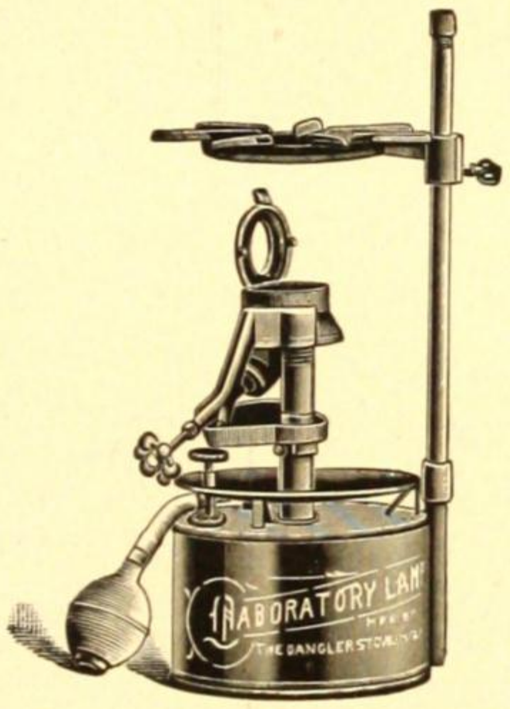
No. 540C.



No. 560C.



No. 565C.



No. 570C.

540C. Burner, Gasoline. Brass, nickel-plated. Burns equally well in all positions. Perfectly automatic, no valves or pump to get out of order. Burns about two hours with one filling. **Caution:** Use only the best gasoline **$2.00**

Repair Parts for No. 540C Gasoline Burner.

542C. Burner Tube **$0.25**

546C. Cleaning Wire ..... **.01**

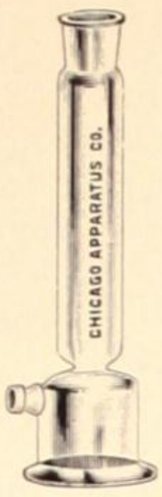
548C. Straight Neck ..... **.50**

554C. Wick and Brass Strip ..... **.20**

560C. Burner, Gasoline. Tank of heavy seamless drawn brass, fitted with rigid burner of bronze alloy, with pump in handle. Capacity of tank, 1 pint; total height, 7 inches. Produces an intensely hot flame, which can be regulated from a small point to a large brush flame. Recommended as the best available substitute for the Bunsen burner or gas blast lamp **$7.75**

565C. Burner, Gasoline. Similar in construction to No. 560C, but mounted on adjustable stand with vessel support. The stand is provided with a swivel so the flame can be pointed in any direction. The pump is of brass, mounted inside the tank, and is automatic in its action. Capacity of tank, 1 pint **$12.00**

570C. Burner, Gasoline. Dangler's blast lamp. Produces a hot flame which is easily adjustable. Capacity of metal reservoir, ½ gallons; diameter, 7 inches. Height to top of support rod, 17 inches. Complete with adjustable support and pressure bulb **$14.00**



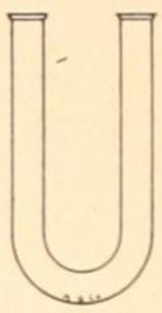
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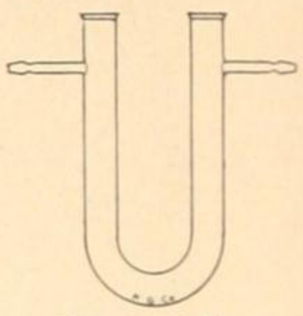
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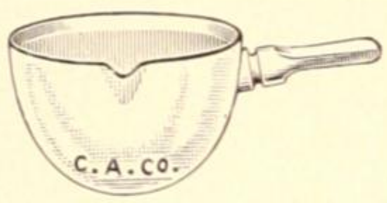
No. 580C.



No. 585C.



No. 590C.



No. 600C.



No. 604C.

Calcium Chloride Jars and Tubes

572C. **Calcium Chloride Jars.** Heavy glass, on foot with tubulature near bottom.

Height, inches	8	10	12
Each	**$1.10**	**1.20**	**1.40**

*575C. **Calcium Chloride Tubes.** Glass, one bulb, straight delivery tube.

Cat. No.	575C	576C	577C
Length to bottom of bulb, inches.	4	6	8
Each	**$0.15**	**.18**	**.20**

*580C. **Calcium Chloride Tubes.** Glass, two bulbs, straight delivery tube.

Cat. No.	580C	581C	582C
Length to bottom of bulb, inches.	4	6	8
Each	**$0.20**	**.25**	**.30**

*585C. **Calcium Chloride Tubes.** U-shape, glass, plain.

Cat. No.	585C	586C	587C	588C
Length, inches	4	5	6	8
Each	**$0.20**	**.25**	**.35**	**.40**

*590C. **Calcium Chloride Tubes.** Glass, U-shape, with side tubes.

Cat. No.	590C	591C	592C
Length, inches	4	6	8
Each	**$0.30**	**.35**	**.40**

***20% discount in lots of 50.**

615C. **Chlorine Tube.** For showing the decomposition of water by chlorine. A glass tube 100 cm. long and 2 cm. in diameter with one end drawn out for about 15 cm. to a diameter of 1 cm. **$0.50**

597C. **Casseroles, Agateware.** With handles.

Mfg. rated capacity, ounces	32	64
Each	**$0.45**	**.55**

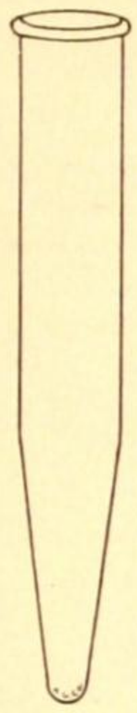
600C. **Casseroles, Porcelain.** With lip and porcelain handle, glazed with exception of rim.

Cat. No.	600C	601C	602C	603C
Capacity, cc.	75	150	210	375
Outside diameter, mm.	70	85	95	110
Each	**$0.60**	**.70**	**.80**	**1.05**

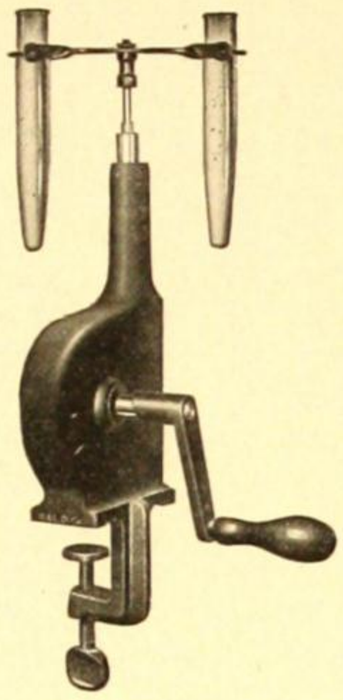
604C. **Cement, Sealo.** For sealing joints in condensers, extraction apparatus, other set-ups, distillation apparatus, gas analysis apparatus, vacuum pump connections, etc. Also for sealing museum jars culture tubes, culture jars and plates; mounting botanical specimens; cementing and insulating wires, etc. Seals all joints leakproof. It is waterproof, flexible, insoluble, insulating, adhesive, non-inflammable, and melts at 400° F. Sets on contact with air and dries hard in a few minutes.

Per ounce tube **$0.25**

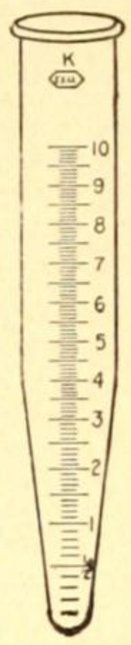
Centrifuge and Accessories



No. 792B.



No. 790B.



No. 791B.

790B. Centrifuge, Hand. Compactness, durability, simplified construction and efficient operation characterize this centrifuge. The gears and pinions are enclosed in a case which rigidly supports the spindle shaft and protects the mechanism from moisture and dust. The handle construction renders impossible a sudden stop that would otherwise spill the contents of the tubes. The speed may be varied. The clamp permits of rigid attachment to table top. Complete with sedimentation attachment; one 15 cc. graduated tube, one 15 cc. ungraduated tube, two aluminum shields to hold and protect tubes.....**$12.00**

791B. Sedimentation Tubes, Glass, Graduated. Capacity, 15 cc.; conical bottom; graduated to 10 cc. in $\frac{1}{10}$ cc. divisions and in 1 cc. divisions to 15 cc. Fits any metal shield or sedimentation arm designed for 15 cc. tubes.....**$0.50**

792B. Sedimentation Tubes, Glass, Ungraduated. Capacity, 15 cc. Same shape and size as No. 791B.**$0.12**

793B. Shield, Aluminum. For 15 cc. tube, to fit on centrifuge No. 790B **$0.35**

794B. Glass Tube, Plain. 15 cc., Pyrex, to fit shield No. 793B **$0.25**

795B. Glass Tube, Graduated. 15 cc., Pyrex, same graduations as No. 791B **$0.80**

796B. Head, Two-Place. For 50 cc. tubes. Fits No. 790B centrifuge, without shields or glass tubes.**$6.50**

797B. Shield, Aluminum. For 50 cc. tubes, for use with above head **$0.35**

798B. Glass Tube, Graduated. 50 cc. With conical bottom. For use on centrifuge No. 790B when provided with 50 cc. head and 50 cc. aluminum shield **$0.60**

799B. Glass Tube, Graduated, Pyrex. 50 cc. Same as No. 798B, but Pyrex glass **$1.40**

800B. Glass Tube, Plain. 50 cc. Same as No. 798B, except ungraduated **$0.30**

801B. Glass Tube, Plain. 50 cc., Pyrex. Same as No. 800B, but Pyrex glass **$0.50**

802B. Casein Tube, Hart's. Fits 50 cc. centrifuge shield. For figuring casein in milk, 50 cc. with stem graduated to 0.2% casein **$0.50**

Charcoal Sticks. Finest quality for blowpipe work. Straight sticks, large size, 116x25x16 mm. In packages containing one dozen sticks.
Per dozen sticks **$0.90**
Per gross sticks **9.00**

INTERNATIONAL TABLE OF ATOMIC WEIGHTS OF THE CHEMICAL ELEMENTS

AS REPORTED BY THE U. S. BUREAU OF STANDARDS

Element	Symbol	Atomic Number	Atomic Weight	Element	Symbol	Atomic Number	Atomic Weight	Element	Symbol	Atomic Number	Atomic Weight
Aluminum	Al	13	26.97	Holmium	Ho	67	163.4	Rhenium	Re	75	188.
Antimony	Sb	51	121.77	Hydrogen	H	1	1.008	Rhodium	Rh	45	102.91
Argon	A	18	39.91	Indium	In	49	114.8	Rubidium	Rb	37	85.44
Arsenic	As	33	74.96	Iodine	I	53	126.932	Ruthenium	Ru	44	101.7
Barium	Ba	56	137.37	Iridium	Ir	77	193.1	Samarium	Sa	62	150.43
Beryllium	Be	4	9.02	Iron	Fe	26	55.84	Scandium	Sc	21	45.10
Bismuth	Bi	83	209.00	Krypton	Kr	36	82.9	Selenium	Se	34	79.2
Boron	B	5	10.82	Lanthanum	La	57	138.90	Silicon	Si	14	28.06
Bromine	Br	35	79.916	Lead	Pb	82	207.20	Silver	Ag	47	107.880
Cadmium	Cd	48	112.41	Lithium	Li	3	6.940	Sodium	Na	11	22.997
Calcium	Ca	20	40.07	Lutecium	Lu	71	175.0	Strontium	Sr	38	87.63
Carbon	C	6	12.000	Magnesium	Mg	12	24.32	Sulfur	S	16	32.064
Cerium	Ce	58	140.25	Manganese	Mn	25	54.93	Tantalum	Ta	73	181.5
Cesium	Cs	55	132.81	Masurium	Ma	43	99.	Tellurium	Te	52	127.5
Chlorine	Cl	17	35.457	Mercury	Hg	80	200.61	Terbium	Tb	65	159.2
Chromium	Cr	24	52.01	Molybdenum	Mo	42	96.0	Thallium	Te	81	204.39
Cobalt	Co	27	58.94	Neodymium	Nd	60	144.27	Thorium	Th	90	232.15
Columbium	Cb	41	93.1	Neon	Ne	10	20.2	Thulium	Tm	69	169.4
Copper	Cu	29	63.57	Nickel	Ni	28	58.69	Tin	Sn	50	118.70
Dysprosium	Dy	66	162.52	Nitrogen	N	7	14.008	Titanium	Ti	22	48.1
Erbium	Er	68	167.7	Osmium	Os	76	190.8	Tungsten	W	74	184.0
Europium	Eu	63	152.0	Oxygen	Ox	8	16.000	Uranium	U	92	238.17
Fluorine	F	9	19.00	Palladium	Pd	46	106.7	Vanadium	V	23	50.96
Gadolinium	Gd	64	157.26	Phosphorus	P	15	31.027	Xenon	Xe	54	130.2
Gallium	Ga	31	69.72	Platinum	Pt	78	195.23	Ytterbium	Yb	70	173.6
Germanium	Ge	32	72.60	Potassium	K	19	39.096	Yttrium	Yt	39	88.9
Gold	Au	79	197.2	Praseodymium	Pr	59	140.92	Zinc	Zn	30	65.38
Hafnium	Hf	72	180.	Radium	Ra	88	225.95	Zirconium	Zr	40	91.
Helium	He	2	4.00	Radon	Rn	86	222.				

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No. 605C.

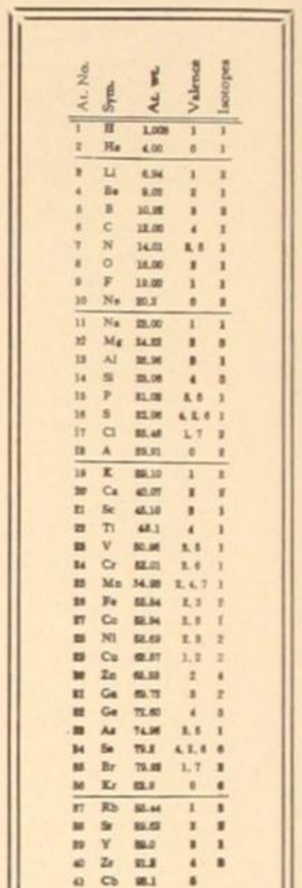
PERIODIC ARRANGEMENT OF THE ELEMENTS

According to 1929 Report of American Chemical Society

GROUPS	O	I	II	III	IV	V	VI	VII	VIII
PERIODS 1		H-1.0078 1 HYDROGEN							
2	HE-4.002 2 HELIUM	LI-6.940 3 LITHIUM	BE-9.02 4 BERYLLIUM	B-10.82 5 BORON	C-12.000 6 CARBON	N-14.008 7 NITROGEN	O-16.0000 8 OXYGEN	F-19.00 9 FLUORINE	
3	NE-20.183 10 NEON	NA-22.997 11 SODIUM	MG-24.32 12 MAGNESIUM	AL-26.97 13 ALUMINUM	SI-28.06 14 SILICON	P-31.02 15 PHOSPHORUS	S-32.06 16 SULPHUR	CL-35.457 17 CHLORINE	
4	A-39.94 18 ARGON	K-39.10 19 POTASSIUM	CA-40.07 20 CALCIUM	SC-45.10 21 SCANDIUM	TI-47.90 22 TITANIUM	V-50.96 23 VANADIUM	CR-52.01 24 CHROMIUM	MN-54.93 25 MANGANESE	FE-55.84 26 IRON; CO-58.94 27 COBALT; NI-58.69 28 NICKEL
		CU-63.57 29 COPPER	ZN-65.38 30 ZINC	GA-69.72 31 GALLIUM	GE-72.60 32 GERMANIUM	AS-74.96 33 ARSENIC	SE-79.2 34 SELENIUM	BR-79.916 35 BROMINE	RU-101.7 44 RUTHENIUM; RH-102.91 45 RHODIUM; PD-106.7 46 PALLADIUM
5	KR-82.9 36 KRYPTON	RB-85.44 37 RUBIDIUM	SR-87.63 38 STRONTIUM	YT-88.92 39 YTTRIUM	ZR-91.22 40 ZIRCONIUM	CB-93.1 41 COLUMBIUM	MO-96.0 42 MOLYBDENUM	MA-97.8 * 43 MASURIUM	
		AG-107.880 47 SILVER	CD-112.41 48 CADMIUM	IN-114.8 49 INDIUM	SN-118.70 50 TIN	SB-121.77 51 ANTIMONY	TE-127.5 52 TELLURIUM	I-126.932 53 IODINE	
6	XE-130.2 54 XENON	CS-132.81 55 CAESIUM	BA-137.36 56 BARIUM	Rare Earths 57-71 (See Table Below)	HF-178.6 72 HAFNIUM	TA-181.5 73 TANTALUM	W-184.0 74 TUNGSTEN	RE-188.7 75 RHENIUM	OS-190.8 76 OSMIUM; IR-193.1 77 IRIDIUM; PT-195.23 78 PLATINUM
		AU-197.2 79 GOLD	HG-200.61 80 MERCURY	TL-204.39 81 THALLIUM	PB-207.22 82 LEAD	BI-209.00 83 BISMUTH	PO-210.0 * 84 POLONIUM	——— 85	
7	RN-222.0 86 RADON	87	RA-225.97 88 RADIUM	AC-229. * 89 ACTINIUM	TH-232.12 90 THORIUM	PA-234 * 91 PROTACTINIUM	U-238.14 92 URANIUM	Small numerals in upper right hand corners refer to Atomic Numbers	
RARE EARTHS 57-71 138.90-175.0	LA-138.90 57 LANTHANUM	CE-140.13 58 CERIUM	PR-140.92 59 PRASEODYMIUM	ND-144.27 60 NEODYMIUM	——— 61	SA-150.43 62 SAMARIUM	EU-152.0 63 EUROPIUM	GD-157.26 64 GADOLINIUM	TB-159.2 65 TERBIUM
	DY-162.46 66 DYSPROSIUM	HO-163.5 67 HOLMIUM	ER-167.64 68 ERBIUM	TM-169.4 69 THULIUM	YB-173.6 70 YTTERBIUM	LU-175.0 71 LUTECIUM	* The Atomic Weights for these Elements have not yet been accurately determined. The values given in this chart are therefore approximate only. They were supplied to us by Harvard University.		

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Scientific Instruments - Laboratory Supplies - Chemicals

No. 610C.



No. 612C.

605C. Chart, Atomic Weight. Gives the name, symbol, atomic number and atomic weight, as reported by the U. S. Bureau of Standards, for each element in the international table of chemical elements. Basis, Oxygen=16. Size, 42x62 inches. Printed on cloth and provided with wood rollers and eyelets for hanging **$3.50**

610C. Chart, Periodic System, Mendelejeff. Basis, Oxygen (O)=16. Compiled by Dr. F. W. Clarke. American nomenclature. Size 42x62 inches. Mounted on common rollers **$3.50**

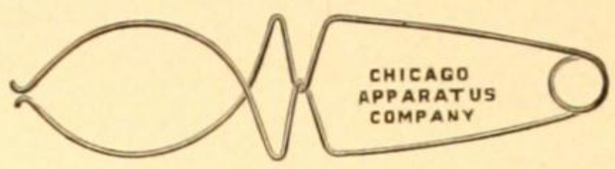
612C. Chemrule. A wood ruler which in addition to the metric scale has important chemical data, including atomic numbers, symbols, valences and isotopes as well as periodic relationships. The atomic weights have been verified by Professor Baxter, of the International Committee, and the isotopes by the National Research Council. Highly recommended for the chemistry student or instructor.

Each **$0.15**
Per ten **1.00**

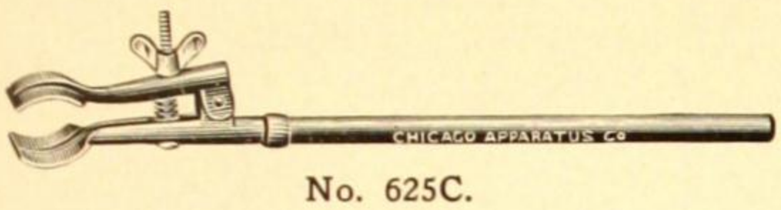
CLAMPS



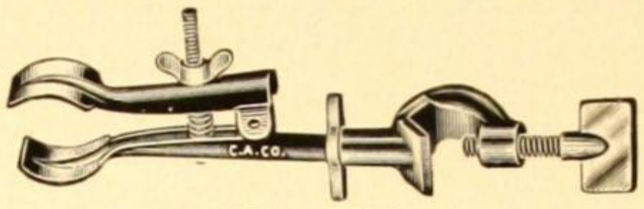
No. 620C, Small.



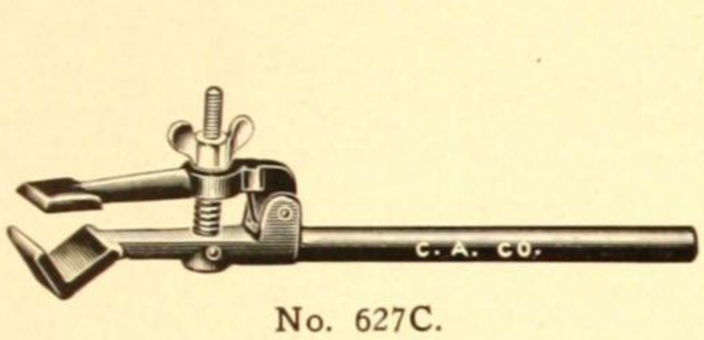
No. 621C, Large.



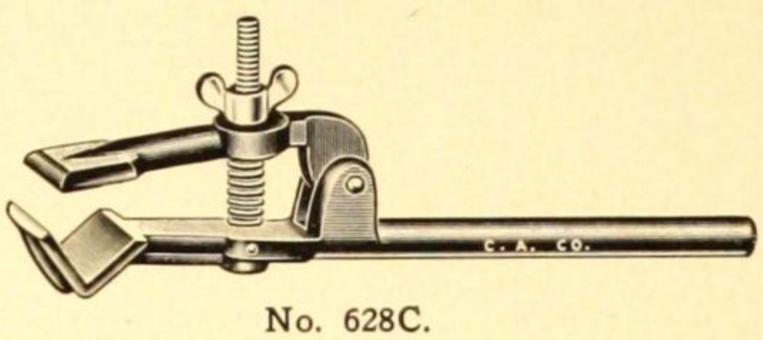
No. 625C.



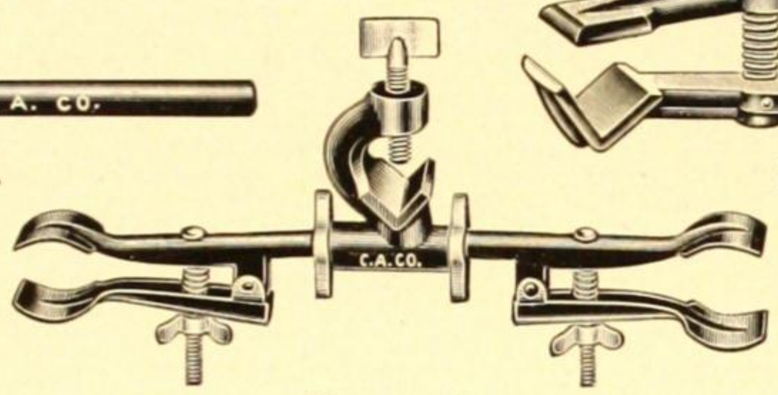
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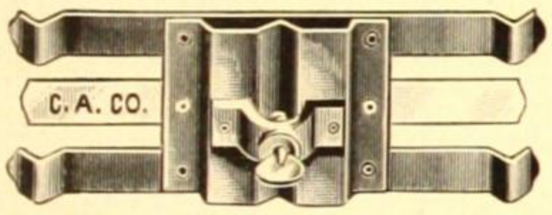
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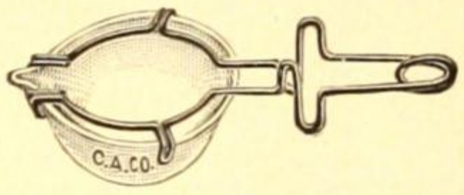
No. 628C.



No. 640C.



No. 645C.



No. 647C.

620C. Clamp, Beaker, Chaddock's. For holding beakers, evaporating dishes, etc. Made of japanned spring steel wire.

Cat. No.	620C	621C
For beakers of capacity, cc.	65 to 350	150 to 1000
For dishes of diameter, mm.	45 to 105	55 to 135
Each	**$ 0.20**	**$ 0.25**
Per dozen	**2.15**	**2.70**
Per hundred	**15.00**	**18.75**

*625C. **Clamp, Bunsen.** Rounded stamped steel jaws. For burettes, tubes, etc., up to 1 5/16 inches in diameter. Maximum opening of jaws 2 inches. For attaching to support by means of clamp holder (No. 665C). Total length 9 inches; diameter of rod, 5/16 inch **$0.30**

*626C. **Clamp, Bunsen.** Same as No. 625C, but with jaws rubber-covered **$0.35**

*630C. **Clamp, Bunsen.** Same as No. 625C, but with nickel-plated rod 12 inches long by 5/16 inch in diameter **$0.60**

*635C. **Clamp, Burette.** Rounded stamped steel jaws with check nut to adjust in any position. For holding tubes, burettes, etc., up to 1 5/16 inches in diameter. Provided with clamp and screw for attaching to support rods up to ½ inch in diameter..... **$0.35**

*636C. **Clamp, Burette.** Same as No. 635C, but with jaws rubber-covered **$0.40**

*627C. **Clamp, Bunsen.** Strong V-shaped cast iron jaws, for tubes up to 1¼ inches in diameter. For attaching to supports by means of clamp holder (No. 665C). Total length, 7¾ inches **$0.50**

*628C. **Clamp, Bunsen.** Same as No. 627C, but larger and stronger. For tubes up to 1½ inches in diameter. Total length, 8¼ inches **$0.60**

*640C. **Clamp, Burette, Double.** Rounded stamped steel jaws, for holding burettes or tubes 1 1/16 inches or less in diameter. For attaching to rods up to ½ inch in diameter **$0.90**

645C. **Clamp, Burette, Double, Lincoln's.** New all-metal type. No wood to warp or stain. Fits support rods up to 19 mm. diameter, and will hold two burettes rigidly and 17.5 cm. apart. Every part of metal, precision-formed. The result is a degree of uniformity, accuracy, and beauty never before attained in this type of clamp. Long parallel V-grooves with strong, wide, flat springs insure firm grip and correct burette position always. The middle groove, full 3 inches long, locks rigidly to a support rod with the slightest tension on the clamping screw, preventing shifting during use. Front springs are cadmium plated; clamping screw, nickel-plated; other parts, black non-chipping gloss enameled.

Each	**$ 0.90**
Dozen	**9.60**
Per 100	**67.50**

*647C. **Clamp, Dish, Stoddard's.** For holding evaporating and other dishes up to 4½ inches in diameter. Of brass wire with white nickel finish.... **$0.20**

***10% discount in lots of 25—25% discount in lots of 100.**

Holdawl Clamps and Their Many Uses

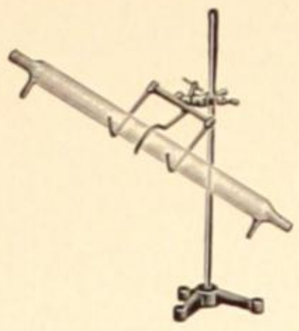


Fig. 1.

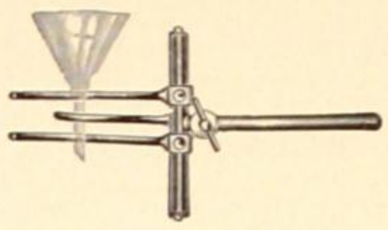


Fig. 2.

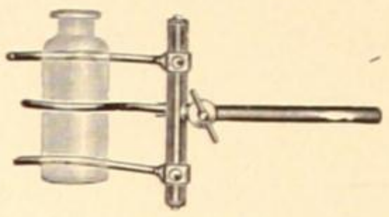


Fig. 3.



Fig. 4.

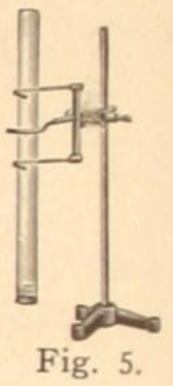


Fig. 5.

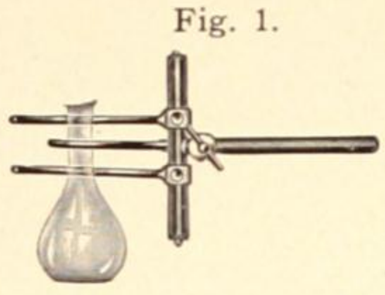


Fig. 6.

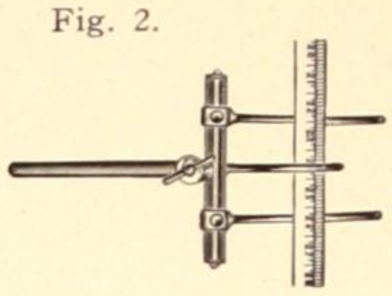


Fig. 7.

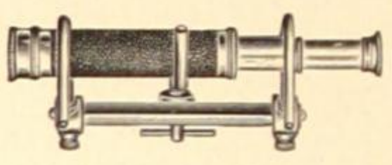


Fig. 8.

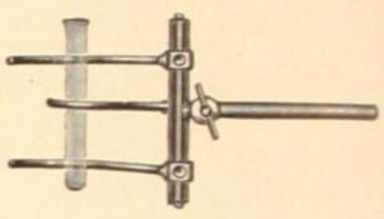
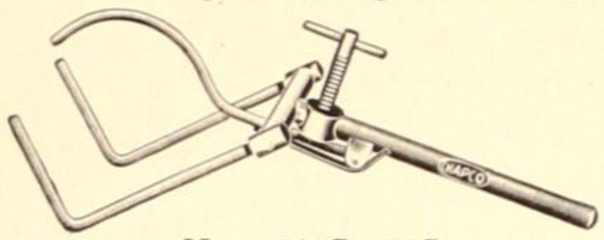


Fig. 9.

The above figures illustrate the many and varied uses to which Holdawl Clamps may be put. Fig. 1. Holding a Liebig's condenser. Fig. 2. Holding glass funnel. Fig. 3. Holding a bottle. Fig. 4. Holding a capillary type Boyle's law tube. Fig. 5. Holding a large glass resonance tube. Fig. 6. Holding a glass flask. Fig. 7. Holding a scale or meter stick. Fig. 8. Holding a telescope. Fig. 9. Holding a glass test tube.



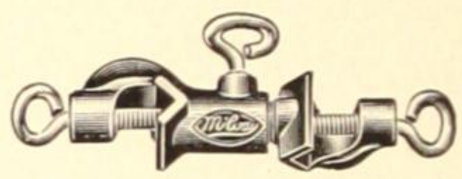
Nos. 650C-655C.



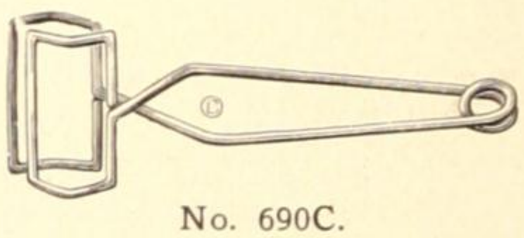
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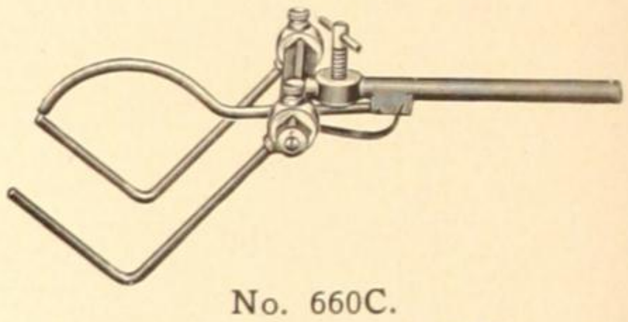
Nos. 680C-681C.



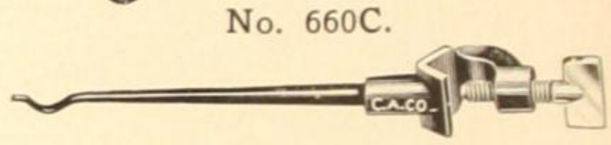
No. 675C.



No. 690C.



No. 660C.



No. 677C.



No. 695C.

650C. Clamp, Holdawl. Small. Made of iron and steel, finished in black japan, nickel-plated screw. Meets practically every laboratory requirement. Holds condensers, small or large tubes, funnels, bottles, flasks, test tubes, telescopes, meter sticks, etc. Rubber tubing can be easily slipped over jaws to protect delicate glassware. To facilitate clamping, the movable jaw is made to open automatically as the screw is turned back. Will clamp any object up to 2¼ inches in diameter; distance between end jaws, 3¼ inches; rod 6 inches long and $\frac{7}{16}$ inch in diameter; for fastening to support by means of our No. 665C Clamp Holder **$1.65**

655C. Clamp, Holdawl. Large. Same as No. 650C, but for clamping articles up to 3¼ inches in diameter; distance between end jaws, 5¼ inches; rod 6x½ inch **$2.25**

660C. Clamp, Holdawl. Adjustable. Similar to above clamps, but constructed so distance between end jaws can be varied from 1½ to 6 inches. For clamping objects up to 3¼ inches in diameter; rod 6 inches long and ½ inch in diameter..... **$4.50**

10% discount in lots of 12 on Nos. 650C, 655C, 660C.

***665C. Clamp Holder.** Iron, with solid brass screws. For fastening clamps to support rods up to $\frac{9}{16}$ inch in diameter **$0.30**

***670C. Clamp Holder.** Large. Same as No. 665C, but for fastening clamps to support rods up to ¾ inch in diameter **$0.40**

***675C. Clamp Holder Swivel.** For attaching clamps at any angle to support rods. The V-openings fit rods up to $\frac{9}{16}$ inch in diameter. Made of japanned iron with solid brass screws..... **$0.70**

***677C. Clamp, Hook.** Provided with small brass hook for holding thermometers, etc.; with clamp screw for attaching to support rods up to ½ inch in diameter **$0.75**

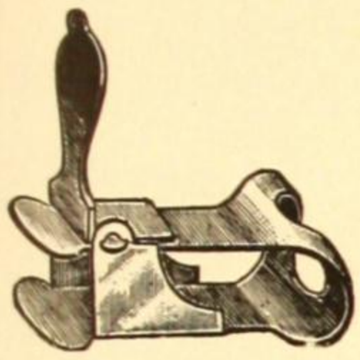
***680C. Clamp, Test Tube. Chaddock's.** For holding test tubes, necks of flasks, small beakers, dishes, etc. Made of japanned spring steel wire.

Cat. No.	680C	681C
For tubes, etc., of diameter, mm.	15 to 40	40 to 100
Each	**$0.20**	**.25**

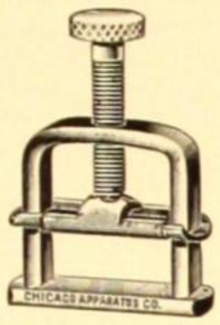
***690C. Clamp, Test Tube. Stoddard's.** Spring brass wire; length 5 inches..... **$0.10**

***695C. Clamp, Test Tube. Wood.** Improved form, with brass spring **$0.15**

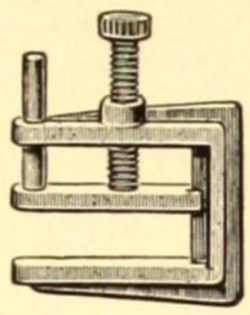
***10% discount in lots of 25—25% discount in lots of 100.**



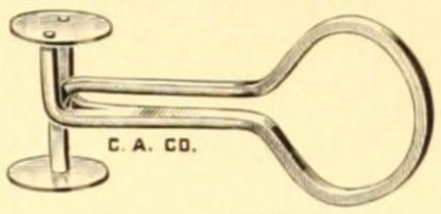
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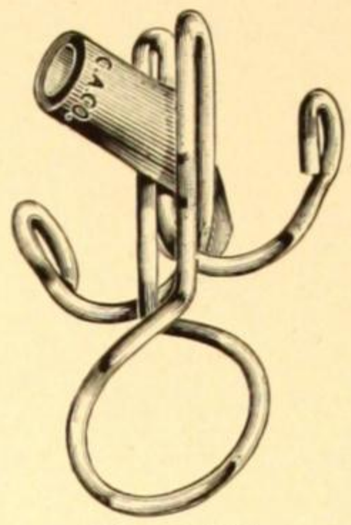
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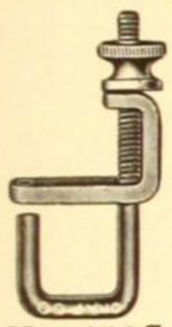
No. 700C.



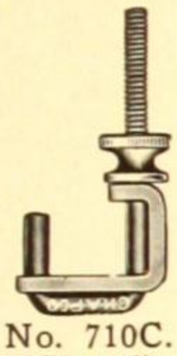
Nos. 705C-707C.



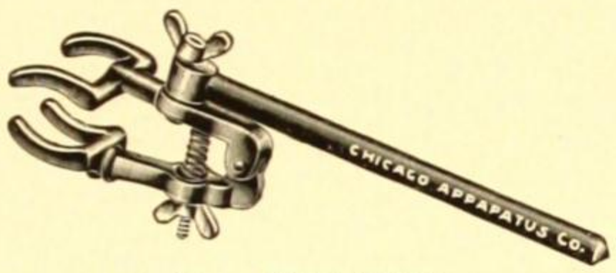
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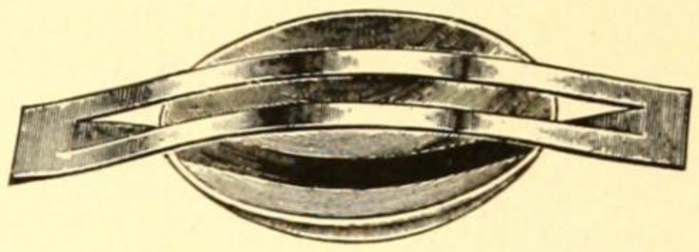
No. 710C. (Open)



No. 710C. (Closed)



Nos. 715C-720C.



No. 721C.

*696C. **Clamps, Tubing, Cut-off.** Brass, nickel-plated. For tubing up to $\frac{5}{16}$ inch..... **Each $0.08**

*697C. **Clamps, Tubing, Hoffman's.** Improved construction. Has two flat clamping faces making it impossible to cut the tubing. Made entirely from hard drawn brass, nickel-plated.

Cat. No.	697C	698C
For tubing up to, inches	½	¾
Each	**$0.25**	**.35**

*700C. **Clamps, Tubing, Hoffman's.** Improved form with open jaw, nickel-plated.

Cat. No.	700C	701C
For tubing up to, inches	½	¾
Each	**$0.25**	**.35**

*705C. **Clamps, Tubing, Mohr's.** (Pinchcocks.) Improved style, made of rectangular rolled nickeled bronze with flat finger grips. Gives flat bearing surface on the tubing, insures close contact and safeguards the tubing. More serviceable and more durable than the old round wire type.

Cat. No.	705C	706C	707C
Total length, inches	2	2⅜	2¾
For rubber tubing up to, inches	$\frac{5}{16}$	⅜	½
Each	**$0.13**	**.15**	**.18**

*708C. **Clamp, Tubing, Spring Pinchcock, Day's.** (Patented.) A very serviceable pinchcock that can be placed on and removed from rubber tubing without disconnecting apparatus, constructed of strong nickeled spring wire. Length, 2⅝ inches; for tubing up to ⅜ inch bore..... **$0.18**

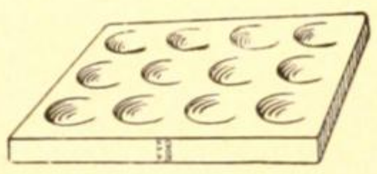
*710C. **Clamps, Tubing. Screw Compressor.** New form, nickel-plated brass; can be placed upon rubber tubing without disconnecting apparatus.

Cat. No.	710C	711C
For rubber tubing up to, inches	$\frac{5}{16}$	½
Each	**$0.20**	**.25**

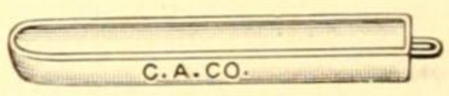
*715C. **Clamp, Universal.** Small. Iron finished in black japan. For condensers, etc.; the jaws adapt themselves to irregular objects. For objects 1¾ inches or less in diameter. Rod 6 inches long, ⅜ inch diameter; for fastening to rod of support by means of our No. 665C Clamp Holder..... **$0.60**

*720C. **Clamp, Universal. Large.** Same as No. 715C, but for objects 2½ inches or less in diameter. Rod, 6¼ inches long; diameter, ½ inch..... **$0.80**

*721C. **Clamp, Watch Glass.** Brass, nickel-plated. For watch glasses up to 2½ inches..... **$0.20**



No. 724C.



No. 725C.

*723C. **Clay Pipe.** Ordinary white clay tobacco pipe. Useful in certain chemical experiments. **Dozen $0.50**

724C. **Color Reaction Plate.** Porcelain, 90x110 mm., with 12 cavities. ..... **Each $0.50**

725C. **Combustion Boats, Porcelain.** Glazed inside and outside.

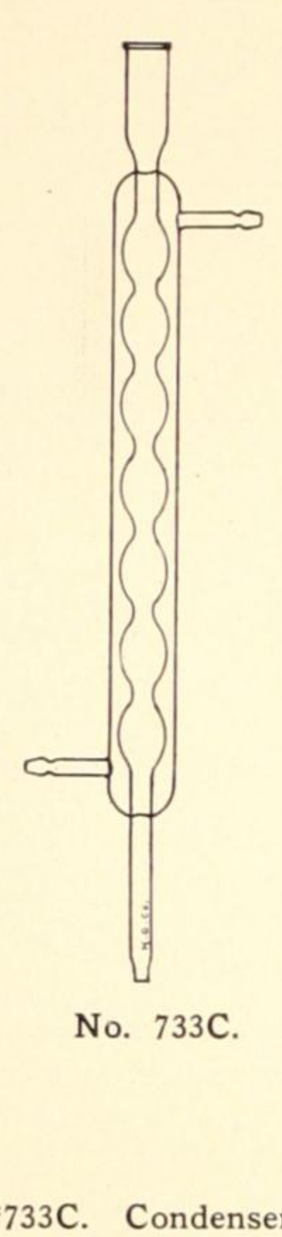
Cat. No.	725C	726C	727C
Length, mm.	60	76	100
Width, mm.	10	11	20
Each	**$0.22**	**.25**	**.30**

731C. **Combustion Tubes, Pyrex Glass.** For use in oxidation and reduction experiments.

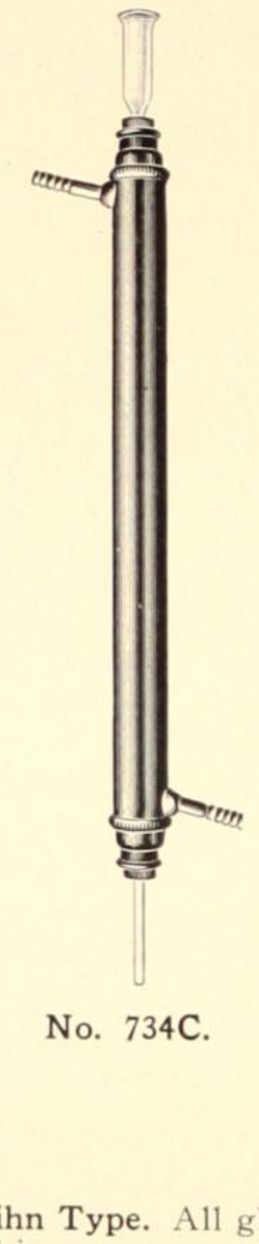
Cat. No.	731C	732C
Length, cm.	25	30
Diameter, inside, mm.	6	15
Each	**$0.20**	**.40**

***10% discount in lots of 25—25% discount in lots of 100.**

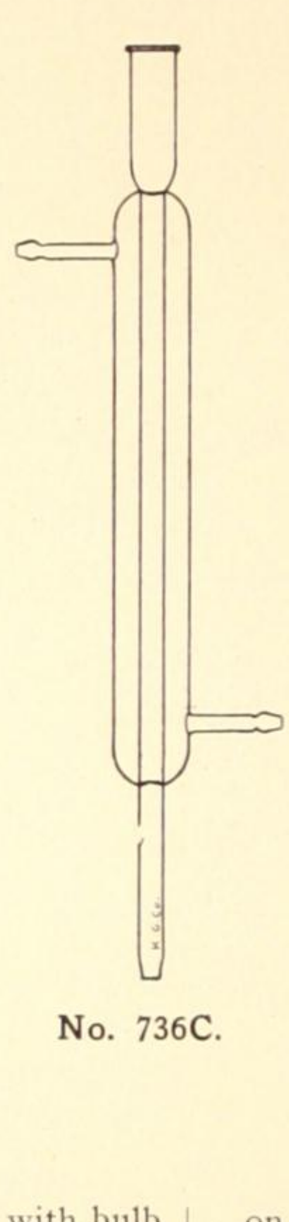
Condensers—All Kinds



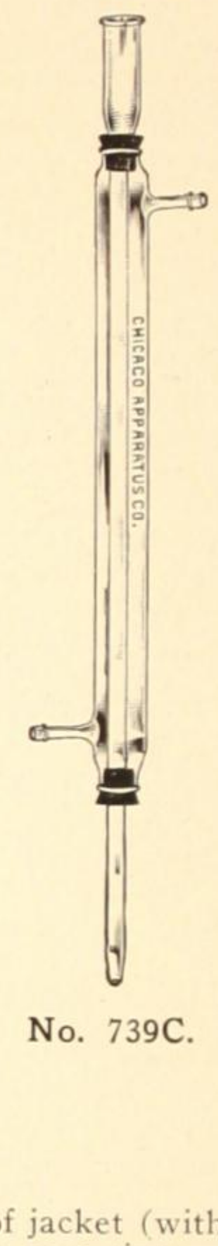
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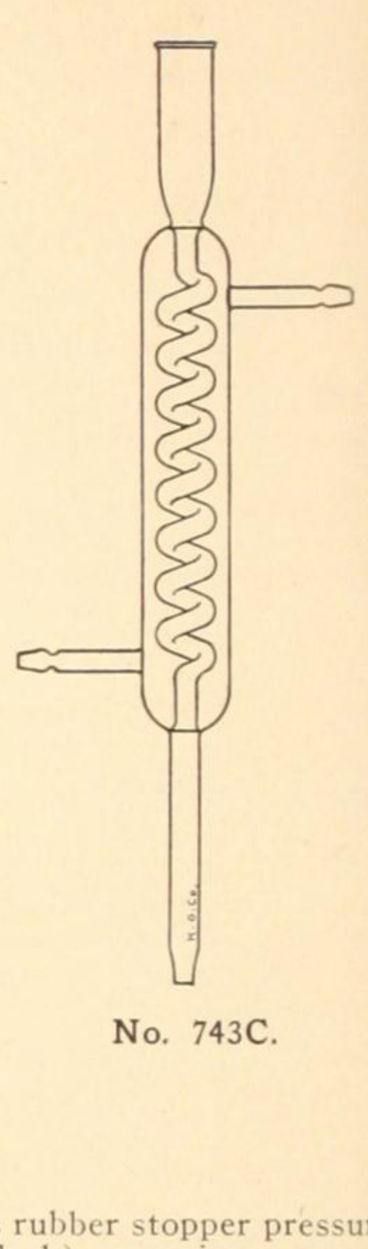
No. 734C.



No. 736C.



No. 739C.



No. 743C.

***733C. Condensers, Allihn Type.** All glass, with bulb condensing tube sealed in.

No.	A	B	C
Length of jacket, inches	8	12	16
Length of condenser, inches	16	20	24
Each	**$1.50**	**1.85**	**2.25**

734C. Condensers, Brass Jacketed, Liebig's. Polished brass jacket fitted with glass condensing tube and rubber stoppers.

No.	A	B
Length of jacket, inches	15	20
Length of condenser tube, inches	25	30
Each	**$4.00**	**4.50**

***736C. Condensers, Liebig.** All glass, with condenser tube sealed to water jacket.

No.	736C	737C	738C
Length of jacket, inches	10	15	20
Length of condenser tube, inches	20	25	30
Each	**$1.10**	**1.50**	**1.75**

***739C. Liebig Condenser, New and Improved Milvay.** Advantages which characterize this new condenser are: Easier to take apart for cleaning; easier to reassemble; greater durability due to heavy ring finish on end of jacket (withstands rubber stopper pressure the same as a ring-necked flask); one-piece, no seal jacket shoulder; leak-proof; absolutely uniform. Pure gum stoppers form perfect seals between condenser tubes and jackets, shouldered hose connectors. The most practical and most durable Liebig condenser now on the market.

No.	739Ca	739Cb	739Cc
Length of jacket, in.	10	15	20
Length of condenser tube, in.	20	25	30
Each	**$1.00**	**1.15**	**1.25**

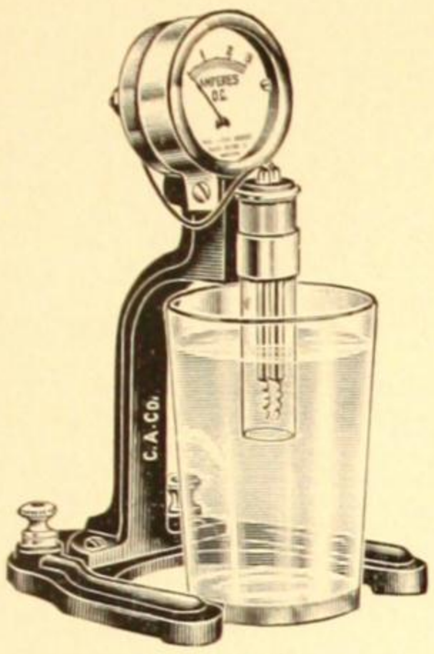
***743C. Condensers, Graham's Type.** All glass, with coiled condensing tube sealed in.

No.	A	B	C
Length of jacket, inches	8	12	16
Length of condenser tube, inches	16	20	24
Each	**$1.75**	**2.00**	**2.25**

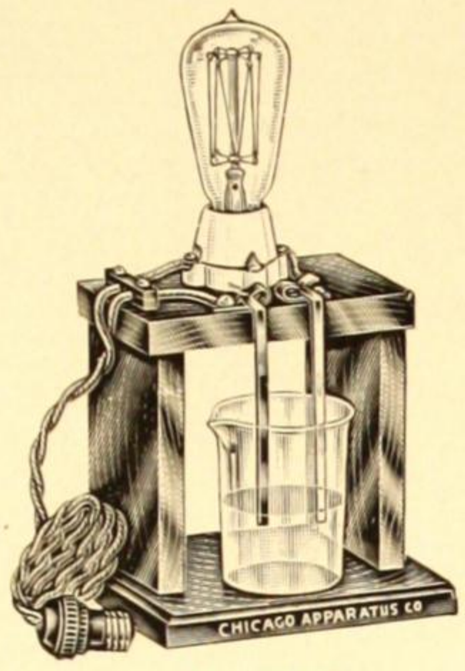
***744C. Condenser Tubes Only.** For Nos. 734C and 739C condensers. Glass, ½ inch diameter.

No.	A	B	C
For condenser jacket, inches	10	15	20
Length, inches	20	25	30
Each	**$0.35**	**.40**	**.45**

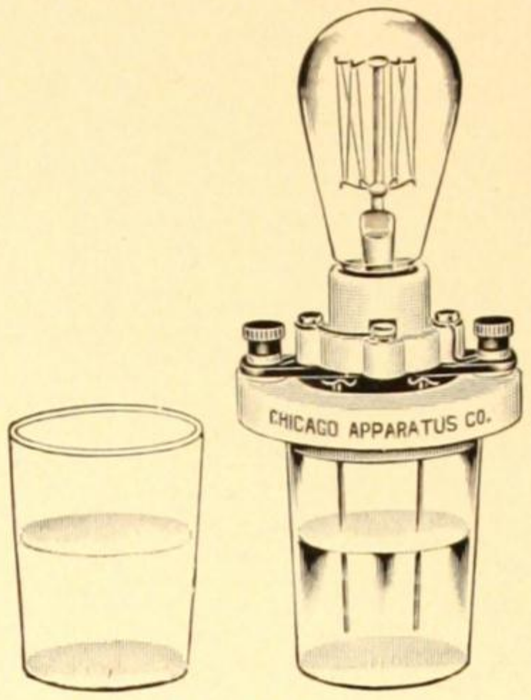
***10% discount in lots of 12.**



No. 745C.



No. 746C.



No. 747C.

745C. Conductivity Cell, Barker's. Made in accordance with design and specifications by Prof. J. W. Barker, Dept. of Chemistry, Wittenberg College, Springfield, Ohio. Practically every laboratory textbook of elementary inorganic chemistry contains an experiment to demonstrate relative ion concentration by the electrical conductance of solutions. The apparatus specified generally consists of an electric light bulb in series with a pair of wire or plate electrodes. Varying light intensities are depended upon to reveal varying concentrations of ions.

While this form is satisfactory for differentiating electrolytes from non-electrolytes, or for showing the wide differences in the conductance of some solutions, it fails to produce conclusive results. And, inconclusiveness breeds carelessness or erroneous impressions.

In the electric light forms the spread between electrodes and the amount of surface immersed may vary, accidentally or otherwise, causing a difference in current flow and hence light tensity, without a corresponding change in ion concentration.

Then, too, the low current consumption of the lamp (usually 0.5 ampere or less) may not permit the passage of all the current which a certain electrolyte could pass between the electrodes. Thus, if a normal HCl solution conducted enough current to cause the lamp to glow at maximum brilliance, a twice normal solution could do no more.

Furthermore, tests have shown that in total darkness, the change in light intensity produced by a change in current of eight per cent could not be detected regularly, the time between observations being fifteen seconds. Under conditions of ordinary illumination in the laboratory, the error was about trebled, because under such conditions it is still more difficult for students to retain a visual estimate of previous observations of the lamp brilliance.

To overcome these defects in the conventional electric light form, this metered conductivity cell was designed, and, during more than two years' use at Wittenberg College, it has given results of considerable scientific value.

The small platinum electrodes are sealed in glass and permanently spaced. They are protected against mechanical displacement by a perforated glass skirt. Because of their small size, the entire electrode is wholly immersed at each observation. Electrodes and protective skirt are quickly cleansed by lifting a beaker of distilled water upon them. The instrument is designed to use ordinary 50 to 250 cc. beakers as solution containers. The D.C. meter has a range of 0.3 amperes in one-tenth divisions. The iron stand with horseshoe base is finished in black-gloss enamel. Any six-volt D.C. current source, such as a storage battery, is suitable for making tests with this cell.

This new form permits successive tests to be conveniently made with rapidity and worth-while accuracy **$7.50**

746C. Conductivity Apparatus, New Design. After Prof. Conrad E. Ronneberg, Itasca Junior College, Coleraine, Minnesota. This type has been used in Professor Ronneberg's laboratory for over two years with excellent results. Simply and rigidly constructed with nothing to get out of order; admirably adapted to student laboratory as well as to instructors' lecture table use; there is very little danger of short circuit; there are no loose wires to be in the way; there is little danger of a student getting an electrical shock; and finally, the electrodes, being exposed and held in place by spring clips, can be easily removed and rinsed off when necessary. For rapidity in testing various solutions this type has no equal. By having the solutions ready in beakers their conducting power can be demonstrated in quick succession, as the design of the apparatus is such that a solution contained in a beaker can be instantly brought into contact with the electrodes. A weak hydrochloric acid solution will cause the electric light to glow brightly. Other acids behave in the same manner although in most cases the light does not glow so brightly, showing that most acids do not conduct the currents so readily as hydrochloric acid.

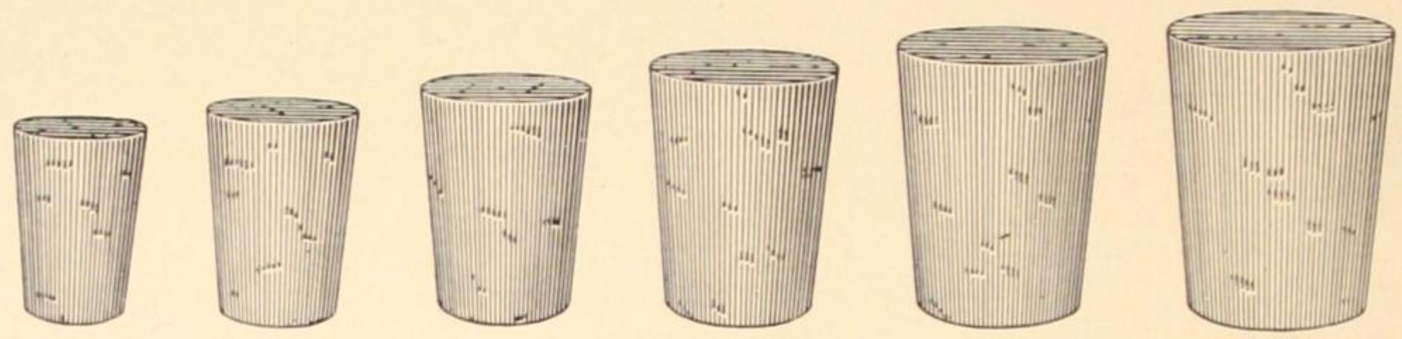
Soluble bases and salts may be tested in the same manner; they are also conductors—electrolytes. Distilled water does not conduct the current, and the lamp does not glow when the electrodes are immersed in it. Solutions of sugar, glycerine, alcohol, ether, and glucose do not allow the current to pass and are, therefore, non-electrolytes. The apparatus may be used on either 110 or 220 volt A.C. or D.C. circuits by inserting a 25 watt Tungsten lamp of proper voltage in the lamp socket.

Furnished as illustrated with 8-foot connecting cord, but without lamp **$3.50**

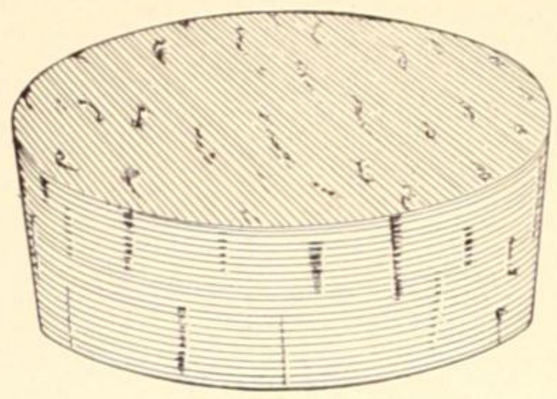
747C. Conductivity of Solutions Apparatus.

This simple inexpensive form is admirably adapted to student and lecture work. There is no danger of getting electrical shocks, as the binding posts are of the insulated type. The nickel electrodes can be easily rinsed off or replaced when necessary. By having the various test solutions ready in suitable beakers, or tumblers, their conducting power can be demonstrated in quick succession by merely moving the tester from one tumbler to another. Operates on either 110 or 220-volt circuit, and a 25-watt Tungsten lamp gives best results. A weak hydrochloric acid solution will cause the lamp to glow brightly, indicating that it is a good conductor. Other acids, and soluble bases will give similar results, since these are also good conductors—that is, electrolytes. Distilled water, solutions of sugar, glycerine, alcohol, ether and glucose are non-conductors, as the absence of glow in the lamp will demonstrate. With poorly conducting solutions the lamp will be dim. The lamp socket and the base upon which it is mounted are of glazed acid-proof, high-insulating porcelain. The electrodes are of pure nickel, as experience has demonstrated this metal to be best for conductivity work.

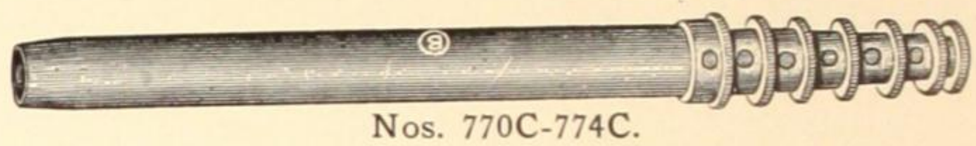
As illustrated, but without lamp or tumblers. **$1.25**



Nos. 750C-765C.



No. 768C.



Nos. 770C-774C.

748C. Cork, XX Quality. 2½ inches long by ¾ inch diameter as called for in "Every-day Problems in Science" by Pieper and Beauchamp $0.10

750C. Corks, XX Quality. Regular length.

No.	0	1	2	3	4	5	6	7	8	9	10
Bottom diameter, inches	¼	5/16	3/8	13/32	7/16	½	9/16	5/8	21/32	¾	13/16
Per 25.	$0.10	.10	.11	.13	.15	.17	.18	.21	.25	.31	.35
Per 100	.25	.25	.28	.30	.35	.38	.40	.45	.51	.62	.70
No.	11	12	13	14	15	16	18	20	22	24	26
Bottom diameter, inches	7/8	15/16	31/32	1	1 1/16	1⅛	1¼	1⅜	1½	1 9/16	1 11/16
Per 10	$0.15	.16	.17	.18	.20	.23	.28	.33	.39	.44	.52
Per 100	.73	.80	.88	.90	.98	1.15	1.40	1.65	2.00	2.40	2.90

752C. Corks, XXXX Quality. Regular length. Far superior for laboratory work to XX quality in soundness and freedom from holes.

No.	1	2	3	4	5	6	7	8	9	10
Bottom diameter, inches	5/16	3/8	13/32	7/16	½	9/16	5/8	21/32	¾	13/16
Per 10	$0.08	.09	.12	.15	.17	.17	.20	.25	.30	.32
Per 100	.40	.45	.50	.60	.75	.85	1.00	1.25	1.50	1.60
No.	11	12	13	14	15	16	18	20	22	24	26
Bottom diameter, inches	7/8	15/16	31/32	1	1 1/16	1⅛	1¼	1⅜	1½	1 9/16	1 11/16
Per 10	$0.33	.35	.40	.45	.50	.60	.75	.85	1.00	1.50	1.65
Per 100	1.65	1.80	2.00	2.30	2.50	3.00	3.50	4.25	5.00	6.00	7.00

755C. Corks, XX Quality. Regular length. Assorted, Nos. 0 to 11. In gross packages only $0.65

760C. Corks, XX Quality. Regular length. Assorted, Nos. 3 to 8. In one-half gross packages only $0.40

765C. Corks, XX Quality. Regular length. Assorted, Nos. 12 to 26. In gross packages only $2.35

768C. Corks, Flat Specie, XX Quality. For wide-mouth bottles and jars. The small diameter is ⅛ inch less than the large diameter. Numbers 1 to 6 are ½ inch long. Numbers 7 to 17, 5/8 inch long.

No.	1	2	3	4	5	6	7	8	9
Large diameter, inches	¾	7/8	1	1⅛	1¼	1⅜	1½	1⅝	1¾
Per 10	$0.20	.20	.25	.30	.35	.40	.40	.45	.55
Per 100	1.05	1.05	1.15	1.40	1.45	1.95	2.00	2.45	2.90
No.		10	11	12	13	14	15	16	17
Large diameter, inches		1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾
Per 10		$0.60	.70	.80	.90	1.00	1.20	1.30	1.60
Per 100		3.20	3.70	3.95	4.80	5.10	6.00	6.50	8.00

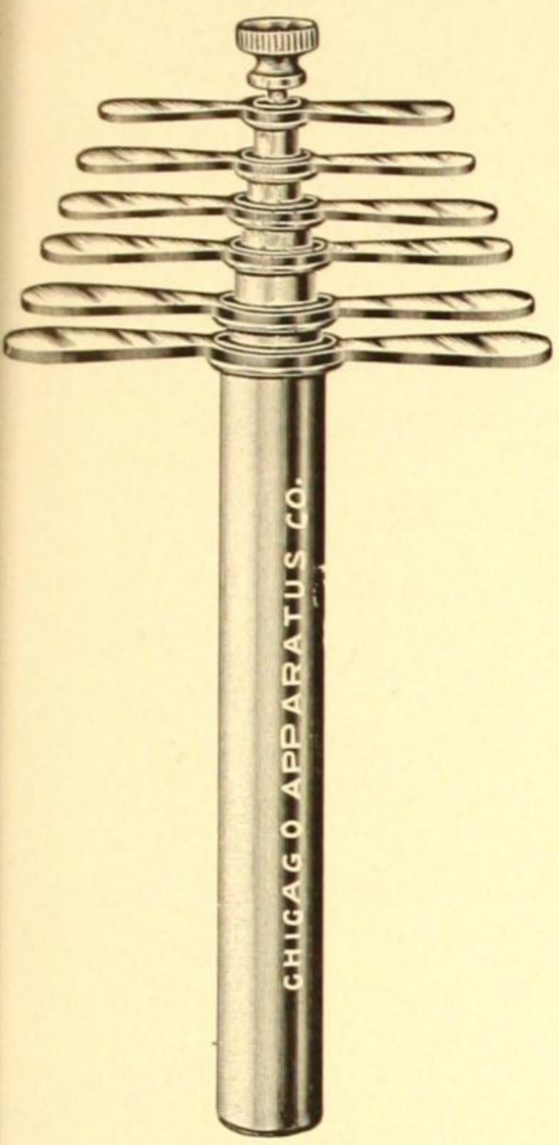
865B. Cork Sheet. Size, 4x12 inches by ⅛ inch thick $0.20

866B. Cork Sheet. Size, 4x12 inches by 3/16 inch thick ..... .30

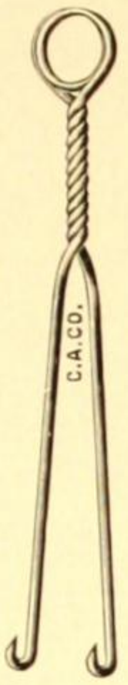
***770C. Cork Borers.** In sets. Hard brass, nickel-plated, keen edges, with punch for each set.

Cat. No.	770C	771C	772C	773C	774C
Number in set	3	6	9	12	15
Diameter, mm.	4 to 7	4 to 11	4 to 14	4 to 17	4 to 21
Per set	$0.50	1.00	1.75	2.50	3.50

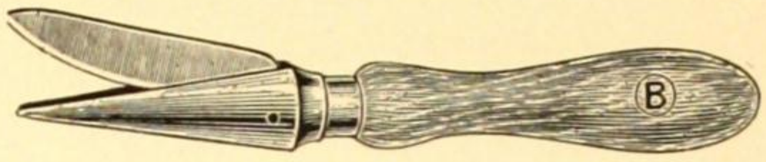
***10% discount in lots of 12—25% discount in lots of 100.**



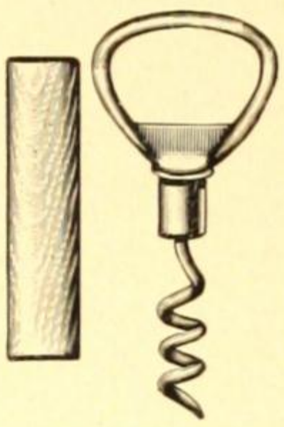
Nos. 775C-779C.



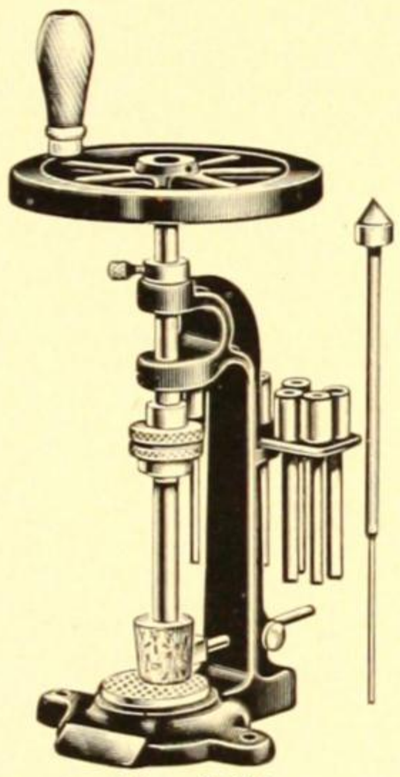
No. 782C.



No. 780C.



No. 786C.



No. 783C.



No. 785C.

*775C. **Cork Borers.** In sets. With individual brass handle, hard brass borers, nickel-plated, keen edges, with punch for each set.

Cat. No.	775C	776C	777C	778C	779C
Number in set	3	6	9	12	15
Diameter, mm.	4 to 7	4 to 11	4 to 14	4 to 17	4 to 21
Per set	**$0.70**	**1.15**	**1.90**	**2.80**	**3.50**

780C. **Cork Borer Sharpener.** For resharpening the cutting edges on all sizes of brass cork borers. Steel cone with knife, mounted in hardwood handle.....**$1.25**

782C. **Cork Extractor.** Of metal, for extracting corks that have been pushed inside of a bottle.....**$0.20**

783C. **Cork Boring Machine.** Will drill both rubber and cork stoppers. Has arrangement for holding the borers and can be screwed solidly to table. Complete with 8 borers producing holes from $\frac{3}{16}$ to $\frac{5}{8}$ in. diam...**$18.00**

214C. **Cork Knife.** Round wood handle. Four-inch steel blade ..... **.25**

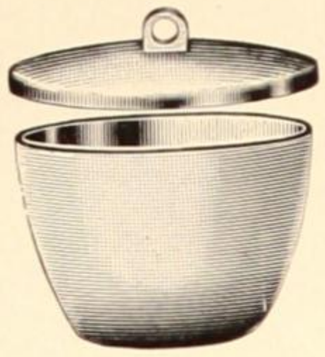
785C. **Cork Press.** Rotary form; for corks up to 1¼ inches in diameter. Made of iron and mounted on wood base **$2.25**

786C. **Cork Screw.** With metal handle and wood shield .....**Each .25**

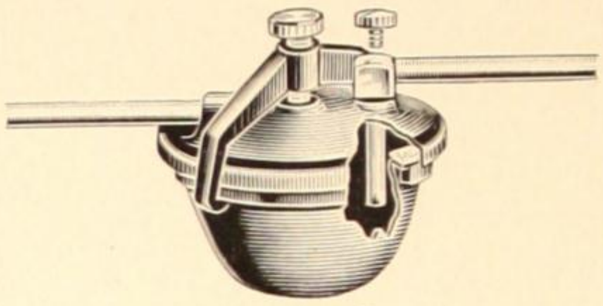
787C. **Cork Screw.** Self-pulling type, large wood handle ..... **.80**

***10% discount in lots of 12—25% discount in lots of 100.**

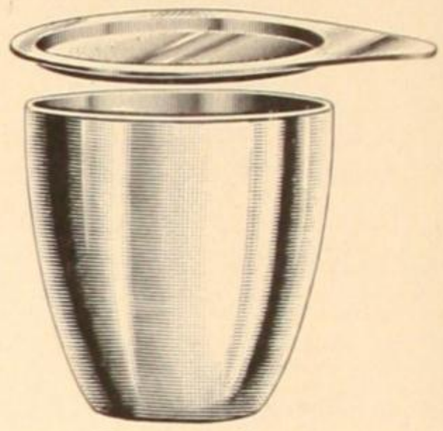
Crucibles



No. 790C.



No. 795C.



No. 796C.

790C. Crucibles, Iron. Spun from sheet, with covers.

Cat. No.	790C	791C	792C	793C
Capacity, cc.	20	50	100	200
Diameter, inches	1½	2⅛	2½	3⅛
Height, inches	1¼	1½	2	2⅜
Each	**$0.25**	**.30**	**.40**	**.50**

795C. Crucibles, Iron. Skidmore's Normal School retort and crucible. Spun iron crucible with cover, clamp and tubes, as illustrated. Can be used as an open or closed crucible or a retort. For making oxygen from manganese dioxide, calcination of chalk, manufacture of soda from cryolite, preparation of ammonia, etc.

No.	A	B
Capacity, ounces	1½	6
Each	**$1.50**	**2.25**

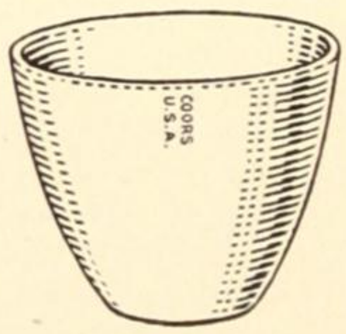
796C. Crucibles, Nickel. With covers.

Capacity, cc.	20	30	50	100	250
Diameter, mm.	35	40	45	60	80
Height, mm.	32	35	40	55	70
Each	**$0.95**	**1.00**	**1.20**	**1.90**	**3.35**

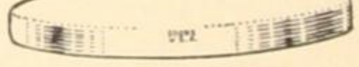
797C. Crucibles, Platinum. With cover. Best grade, hammered to shape, tested, and finely finished.

Capacity, cc.	8	10	15	20	25	30
Diameter, mm.	22	25	30	33	35	40
Depth, mm.	22	25	30	33	35	40
Approximate weight, grams	8	10	15	20	25	30

Prices are kept in accordance with the market on platinum and are quoted on request.



No. 798C.



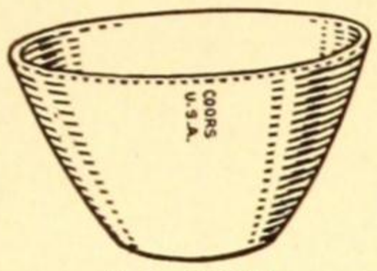
No. 799C.

798C. Crucibles, Porcelain. High form, glazed throughout with exception of outside bottom surface. Without covers. (See No. 799C.)

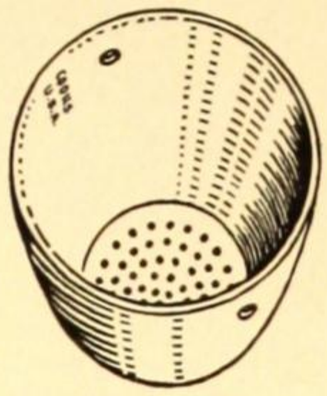
Size No.	00	0	1	2
Capacity, cc.	10	15	30	57
Diameter at top, mm.	30	35	41	52
Height, mm.	25	27	35	43
Each	**$0.12**	**.15**	**.24**	**.30**

799C. Covers, Porcelain, for No. 798C.

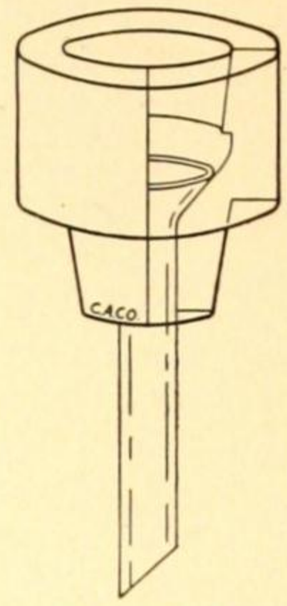
Size No.	00	0	1	2
Diameter, mm.	35	42	47	59
Each	**$0.06**	**.06**	**.08**	**.10**



No. 801C.



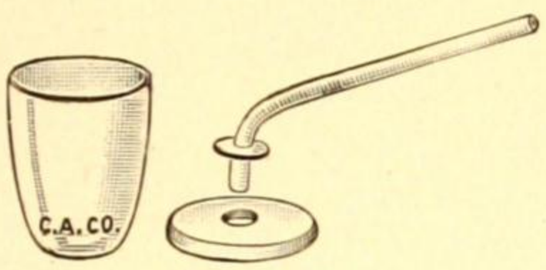
No. 808C.



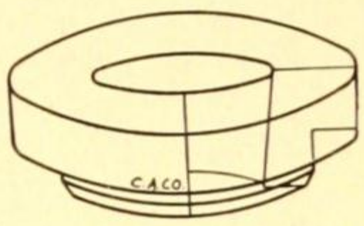
No. 822C.



No. 820C.



No. 815C.



No. 821C.

801C. Crucibles, Porcelain. Wide form, glazed throughout with exception of outside bottom surface. Without covers. (See No. 802C.)

Size No.	000	00	0	1	2	3	4	5
Capacity, cc.	8	12	17	30	50	90	145	265
Diameter at top, mm.	32	37	41	46	56	67	81	96
Height, mm.	19	21	25	29	36	44	52	65
Each	**$0.12**	**.15**	**.18**	**.24**	**.33**	**.40**	**.54**	**.65**

802C. Covers, Porcelain, for No. 801C.

Size No.	000	00	0	1	2	3	4	5
Diameter, mm.	39	44	47	52	65	76	88	107
Each	**$0.06**	**.06**	**.08**	**.08**	**.10**	**.12**	**.16**	**.21**

808C. Crucibles, Porcelain. Gooch Form. Glazed throughout except outside bottom surface. Perforations about 1 mm. in diameter. Without covers. (See No. 799C.)

Capacity, cc.	10	25	35
Diameter at top, mm.	27	35	40
Each	**$0.32**	**.42**	**.45**

799C. Covers, Porcelain, for No. 808C.

Diameter, mm.	35	42	47
Each	**$0.06**	**.06**	**.08**

815C. Crucibles, Porcelain, Rose's. Unglazed, complete with perforated cover and delivery tube.

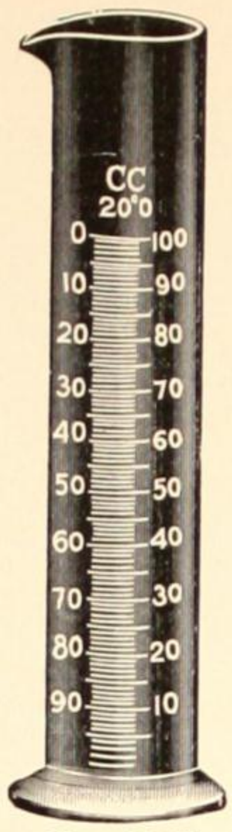
Cat. No.	815C	816C	817C
Capacity, cc.	15	30	60
Diameter at top, mm.	31	39	50
Height, mm.	37	43	60
Each	**$1.15**	**1.25**	**1.50**

820C. Crucibles, Sand Battersea. Round form, without covers.

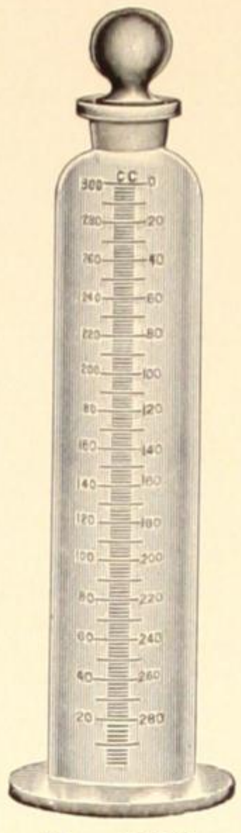
No.	A	B	C	D	E
Diameter, outside, mm.	41	47	57	60	73
Height, outside, mm.	66	76	89	101	114
Each	**$0.20**	**.22**	**.25**	**.25**	**.35**

821C. Crucible Holder, Bailey's. Of semi-soft rubber, to take Gooch 25 cc. crucible. For use with 50 mm. diameter funnel. Holder only **$0.30**

822C. Crucible Holder, Walter's. Of semi-soft rubber, with small glass funnel inserted. Top opening takes 25 cc. Gooch crucible and lower tapered end fits filter flasks of 250 cc. to 1000 cc. capacity. Taper and flange at lower end prevent leakage around lip of the flasks. Holder with funnel only..... **$0.40**

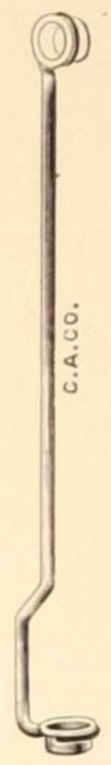


No. 825C.


No. 830C.



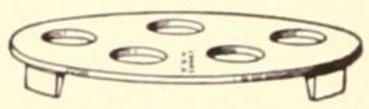
Nos. 835C-840C.

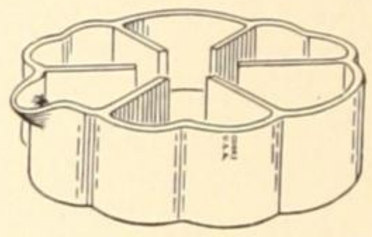


No. 842C.



No. 845C.


No. 850C.


No. 853C.

*824C. **Cylinders, Graduated.** Glass, with lip, on foot, with single graduations and zero at the bottom, to read up.

Capacity, cc.	25	50	100	250
Graduated in, cc.	½	1	1	2
Each	**$0.50**	**.55**	**.65**	**.95**

*825C. **Cylinders, Graduated.** Glass, with lip, on foot, with double graduations to read up and down.

Capacity, cc	10	25	50	100	250	500	1000	2000
Graduated in, cc.	1/5	½	1	1	2	5	10	20
Each	**$0.55**	**.50**	**.55**	**.65**	**1.00**	**1.45**	**2.00**	**3.50**

830C. **Cylinders, Graduated, Glass Stoppered.** Mixing bottles. With double graduations to read up and down.

Capacity, cc.	25	50	100	250	500	1000
Graduated in, cc.	½	1	1	2	5	10
Each	**$0.55**	**.65**	**1.00**	**1.45**	**2.00**	**3.50**

*835C. **Deflagrating Spoon, Brass.** ¾-inch cup, 15-inch handle **$0.15**

*840C. **Deflagrating Spoon, Iron.** ¾-inch cup, 15-inch handle ..... **.10**

842C. **Deflagrating and Combustion Spoon, Parker's.** The cup, ¾ inches in diameter, is removable and can be placed in one ring for use in deflagrations, and in the other for combustion. Length, about 15 in.. **$0.20**

845C. **Desiccator, Scheibler's.** Heavy glass, wide flange, with covers ground air tight.

Cat. No.	845C	846C
Diameter, inches	4	6
Each	**$1.65**	**2.50**

850C. **Desiccator Plates.** Porcelain, glazed on one side, on three small feet.

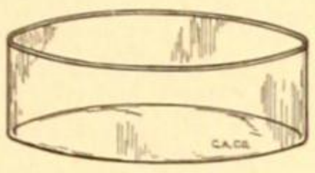
Cat. No.	850C	851C
Diameter, mm.	95	140
Number of holes	3	5
Diameter of holes, mm.	30	30
Each	**$0.60**	**1.10**

853C. **Desiccator Dish, Porcelain.** For acid, diameter 11.5 cm.; height, 38 mm..... **$0.80**

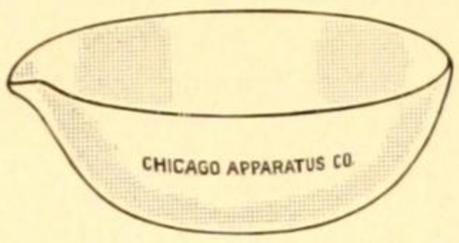
***10% discount in lots of 25—20% discount in lots of 50.**



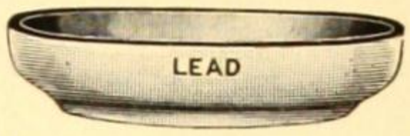
No. 855C.



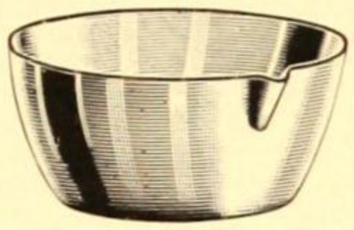
No. 865C.



No. 870C.



No. 875C.



No. 879C.

855C. Diamond Pencil. For writing on glass, one-piece aluminum holder, genuine diamond point..... **$2.75**

857C. Diffusion Shells. Single thickness, test-tube shape, for use in osmosis and dialysis experiments. Superior to parchment paper, either in tubes or sheets, because of shape and the large amount of dialysing surface. Length, 100 mm.; diameter, 16 mm.

Each	**$0.40**
Per box of 25	**5.40**

865C. Dishes, Crystallizing. Thin blown glass, flat bottom, straight sides.

Diameter, mm.	50	80	100	125	150	190
Depth, mm.	35	40	50	65	75	95
Each	**$0.20**	**.30**	**.35**	**.50**	**.60**	**.90**

870C. Dishes, Evaporating. Porcelain, best grade.

No.	000	00a	0	1	2	3	4a	5	6	8
Diameter, mm.	60	75	80	85	90	100	115	120	145	215
Approx. capacity, cc.	35	70	80	100	140	175	250	300	385	1285
Each	**$0.14**	**.18**	**.20**	**.27**	**.34**	**.40**	**.55**	**.60**	**.75**	**1.15**

873C. Dish, Graniteware. Flat bottom, sloping sides, about 18 cm. diameter, about 1 quart capacity..... **$0.25**

874C. Dish, Graniteware. Same as No. 873C but capacity about 2 quarts..... **.45**

875C. Dishes, Lead. For use with hydrofluoric acid in etching glass.

Diameter, mm.	50	75	100
Each	**$0.15**	**.20**	**.25**

878C. Dishes, Milk, Aluminum. Straight side, flat bottom.

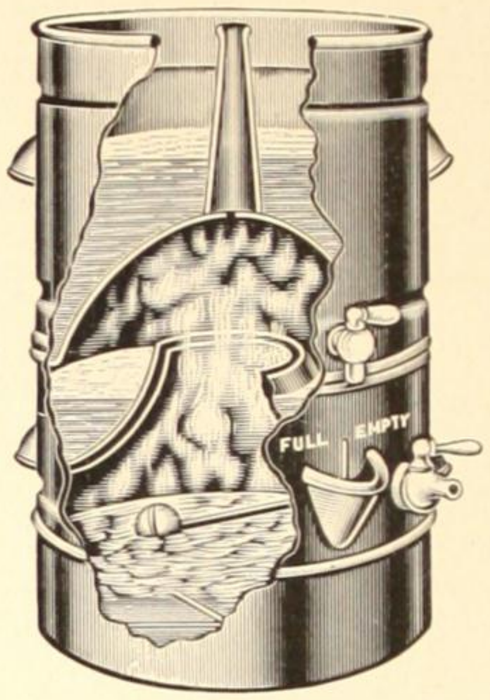
Diameter, mm.	50	65	75	100
Depth, mm.	12	15	20	25
Each	**$0.20**	**.30**	**.35**	**.40**

879C. Dishes, Nickel. Flat bottom, sloping sides, with lip. Made of solid wrought nickel.

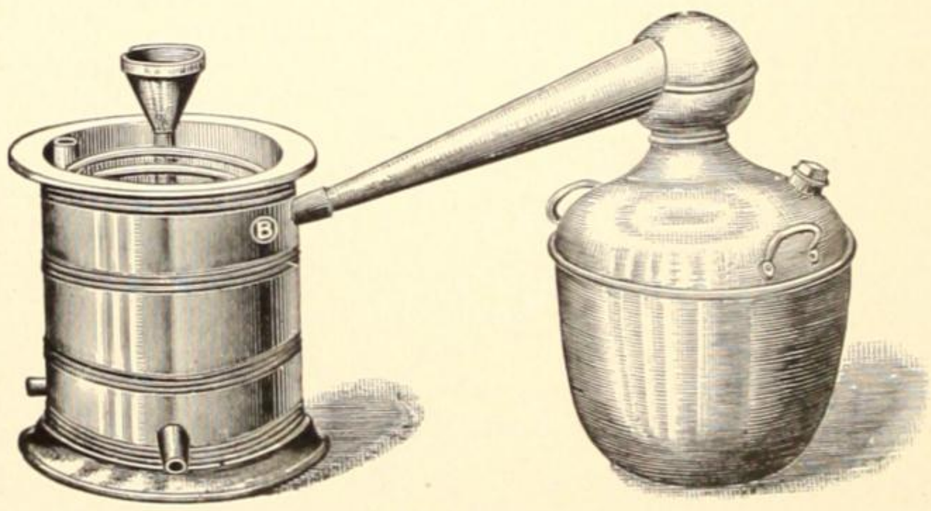
Diameter, cm.	6	8	10	12
Capacity, cc.	40	100	250	325
Each	**$1.20**	**1.80**	**2.50**	**3.25**

Distilling Apparatus

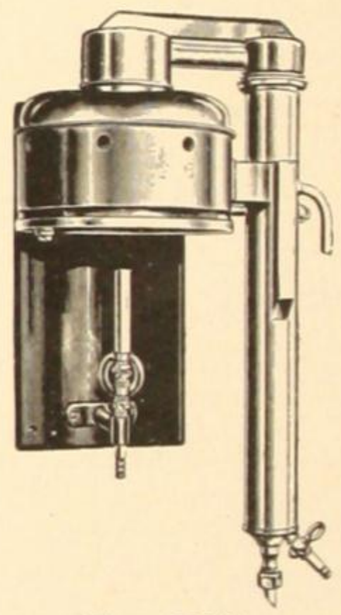
NOTE: The U.S. Internal Revenue regulations require that every still, whether used for water or not, must be registered by both seller and purchaser. To assist our customers in satisfying this requirement, we supply to every purchaser of a Water Still the necessary affidavit forms to be filled out and returned to us. The still is shipped as soon as we obtain permit for shipment. For information concerning the registration of stills, apply to your local Internal Revenue Office.



No. 6025C.



No. 880C.



No. 885C.

6025C. Distilling Apparatus, Ralston's. For preparing small quantities of distilled water over a gas burner or hot plate. Has three compartments: a boiling chamber for raw water, a condensing chamber for condensing the steam and accumulating the distilled water, and a cold-water chamber over the dome of the condensing chamber. The distilled water is drawn from the lower stopcock. When the water in the cooling chamber becomes too hot it is drawn from the upper stopcock and replaced with fresh water. An indicator shows whether boiling chamber is full or empty. This still cannot explode as air circulates through it continuously when in operation. Made of heavy copper, tinned inside and finely finished outside. Overall height, 14 inches; diameter, 9 inches; capacity, about one quart per hour **$16.00**

880C. Distilling Apparatus. Tin lined copper retort, with removable head, and condenser consisting of pure block tin condensing worm enclosed in a zinc vessel.

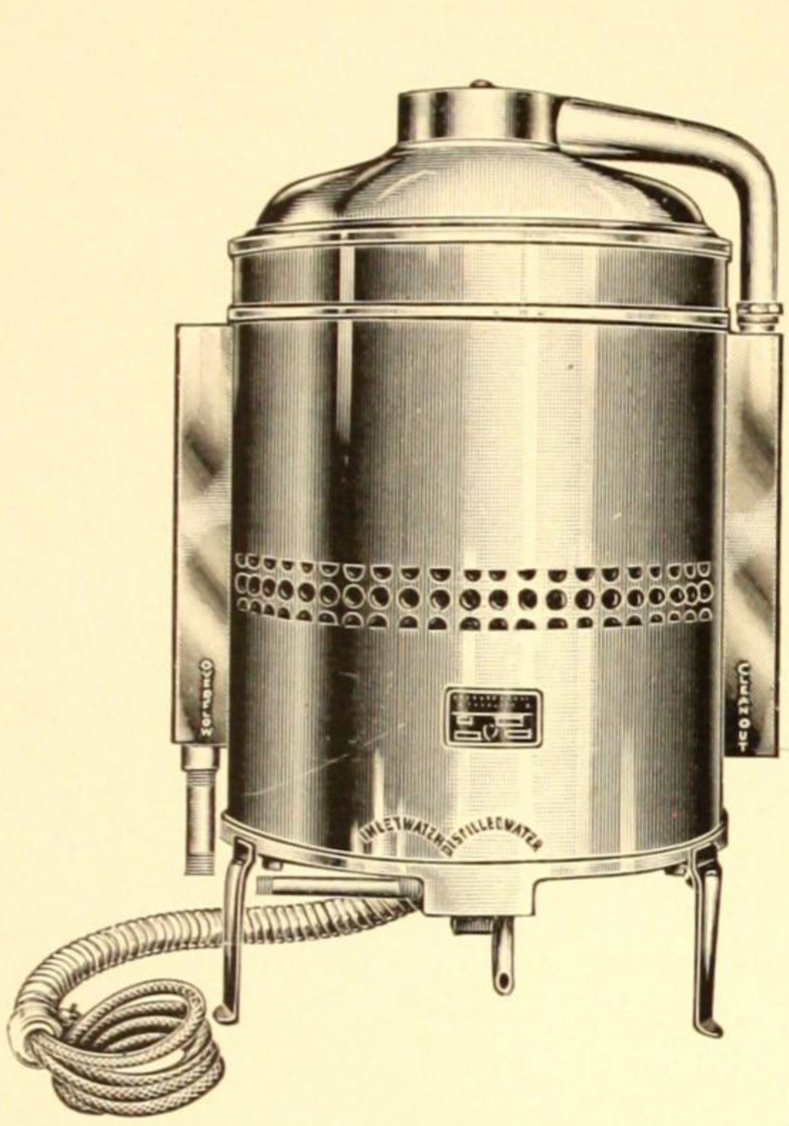
Cat. No.	880C	881C
Capacity, gallons	½	1
Each	**$16.00**	**20.00**

885C. Distilling Apparatus, Rochlitz. Automatic water still. Made to hang on wall, occupies space of 12x4 inches on the wall, projects only 14 inches at widest part. Distills maximum amount of water for minimum consumption of gas. Made of copper and brass, tin lined and nickel-plated. Complete with gas burner.

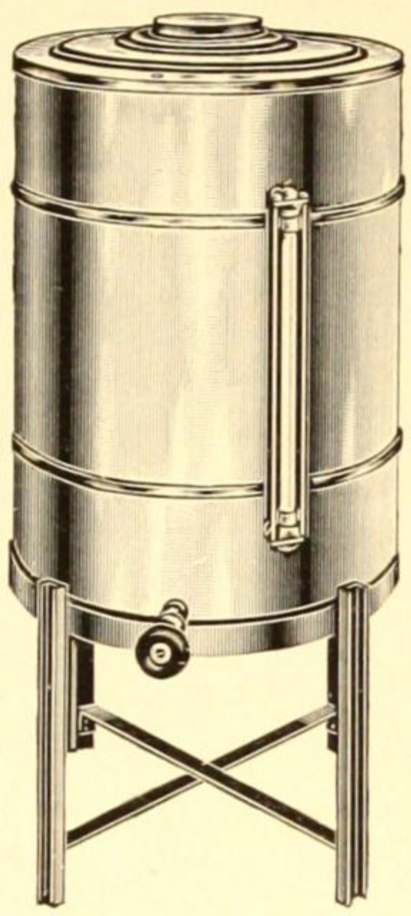
Cat. No.	885C	886C
Capacity, gallons	1	2
Each	**$37.50**	**60.00**

Precision Stills and Storage Tanks

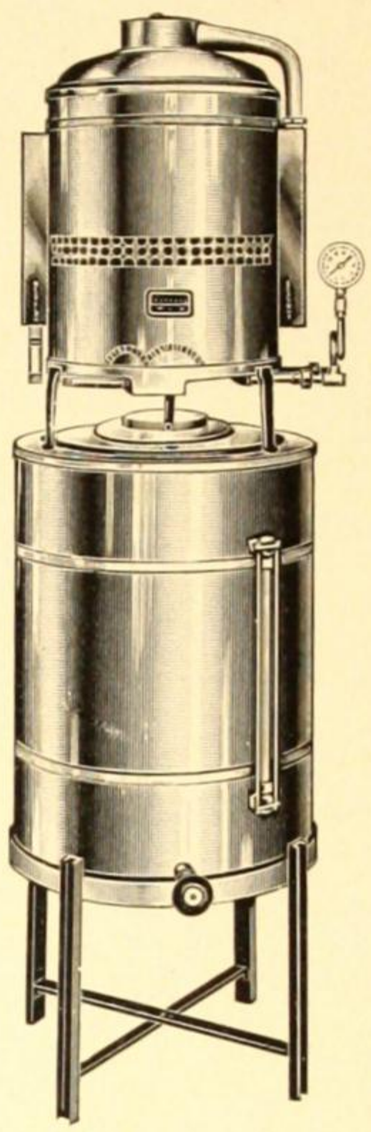
(See note on page 426 under Distilling Apparatus.)



No. 884C.



No. 884Cb.



No. 884Cb (in use).

882C. Distilling Apparatus, Precision. For steam heating. Has these advantages: Easy to clean—top of retort is removable, allowing easy access to every part of boiling chamber. Preheating—raw water is preheated to about 200° F. before entering boiling chamber. Overflow—placed on cold water side, prevents waste of hot water. Removable steam coils—can be taken out for cleaning in less than 5 minutes. Convenient to install—both legs and wall bracket furnished with each still. Efficient—will operate continuously even when only small amount of raw water is fed in. Has clean-out plug—makes it easy to flush out. Rust-proof—no iron used, made entirely of copper and brass. Distilled water is delivered cold and is free from all impurities and gases. Steam gauge and two unions for connection to steam line furnished. Capacity varies with steam pressure. Lower rating is based on 5 to 10 lbs., and higher rating on 20 to 30 lbs. of steam pressure.

Size No.	1	2
Capacity per hour, gallons	1 to 2	2 to 4
Each	**$75.00**	**106.50**

883C. Distilling Apparatus, Precision. For gas heating. Same general construction as No. 882C, but provided with a very efficient burner adjustable for coal, natural and gasoline gas, and provided with a shield to prevent downward radiation.

Size No.	1	2
Capacity per hour, gallons	1	2
Each	**$62.50**	**94.50**

884C. Distilling Apparatus, Precision. For electric heating. Same general construction as No. 882C, but provided with easily removable and replaceable heating units. Complete with 6 ft. heavy B. X. cable for connection to current source. Furnished for use on either 110 or 220-volt A.C. and D.C. circuits. Voltage must be stated when ordering.

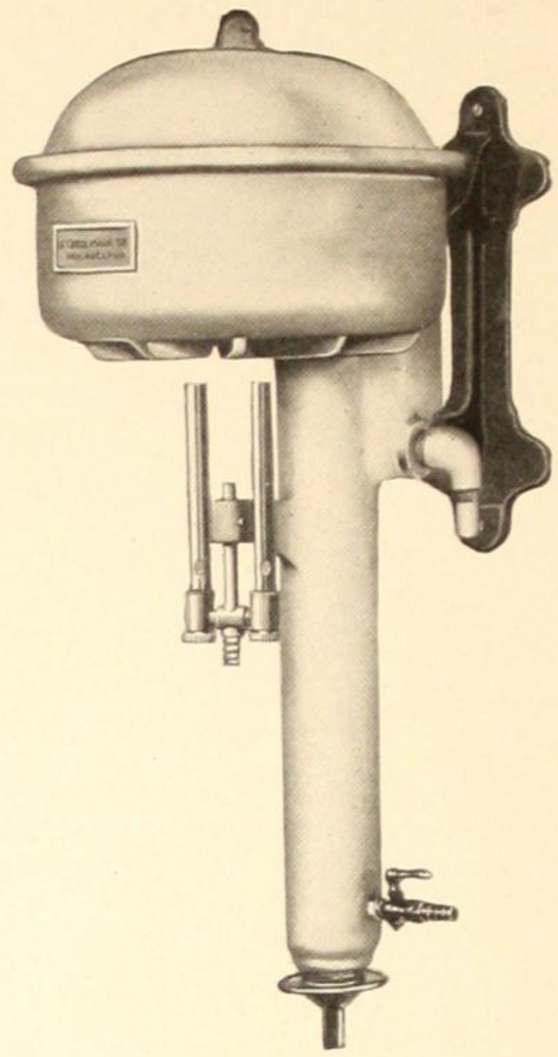
Size No.	1	2	3
Capacity per hour, gallons	1	1½	2
Watts required	2500	3750	5000
Height, inches	22	22	26
Width, inches	15	15	17
Each	**$75.50**	**96.00**	**119.50**

884Cb. Distilled Water Storage Tanks, Precision. Made of heavy copper, tinned inside, provided with gauge glass and tinned faucet. Large opening in top (fitted with cover) makes cleaning easy. Neat iron stand furnished with each tank. Still may be placed directly on top of tank, as illustrated. Distilled water from still will run directly into tank through a small opening. Still and tank together make a compact unit. Far superior, more convenient and safer than collecting and storing distilled water in large glass bottles.

Size No.	1	2	3
Holding capacity, gallons	10	15	25
Each	**$25.00**	**30.00**	**42.50**

Stokes Stills

(See note on page 426 under Distilling Apparatus.)



No. 888C.

887C. Distilling Apparatus, Stokes, Automatic, for Steam Heating. The ingenious construction provides absolutely pure water; free from suspended and dissolved impurities, dissolved gases and bacteria. Efficient and economical—uses the heat generated by the condensing vapor for pre-heating the feed water. Elimination of gases—pre-heating drives off practically all dissolved air, ammonia and other gaseous impurities. Separation of entrainment—an efficient method of baffling separates all entrained drops of raw water from the vapor before it enters the condenser tubes, preventing pollution from this source.

Cleaning—readily flushed out to prevent formation of scale and to remove material which may cause foaming in the boiling chamber.

Durability—simple, strong cast iron construction makes for long life and freedom from accidental breakage. No solder or brazing to melt, no thin metal to burn out. Convenience—all sizes are arranged to hang on the wall. Easy to install, are out of the way and take up no wall or bench space. Being entirely automatic, they require no attention, once the rate of flow of raw water has been regulated. They are self-contained and require only two connections for steam and water. Rated capacities are based on a steam pressure of 20 pounds.

Size No.	00	000	1	2
Capacity, per hour, gallons	¾	2¾	5	10
Height, feet	2	4	3½	4½
Weight, pounds	50	110	275	325
Each	**$30.00**	**75.00**	**150.00**	**200.00**

888C. Distilling Apparatus. Stokes Automatic. For gas heating. Same general design as No. 887C, but with burners for illuminating gas.

Size No.	0	00	000
Number of burners	1	2	6
Capacity, per hour, gallons	½	¾	2¾
Height, feet	2	2	4
Weight, pounds	50	50	110
Each	**$25.00**	**27.00**	**60.00**

889C. Distilling Apparatus, Stokes Automatic. For electric heating. Same general construction as No. 887C, but with unit for electric heating. In ordering, voltage must be stated.

Size No.	0	00	000
Capacity, per hour, gallons	½	¾	2½
Height, feet	2	2	4
Weight, pounds	50	50	110
Watts required	2000	3500	7200
Each	**$45.00**	**55.00**	**90.00**

890C. Eudiometers. Bunsen's straight form, with platinum electrodes.

Cat. No.	890C	891C
Capacity, cc.	50	100
Graduated in, cc.	1/10	1/5
Each	**$2.50**	**3.00**

896C. Eudiometers. Bunsen's, with platinum electrodes, graduated in millimeters to 500 mm. **$3.00**

898C. Fermentation Tubes, Smith's. On glass foot.

No.	898Ca	898Cb
Length of closed tube, mm.	115	140
Diameter of closed tube, mm.	12	15
Each	**$0.35**	**.45**

*900C. **Files, Round.** (Rat tail.) Bastard cut. For perforating corks, etc.

Length, inches (of cut portion only)	4	5	6
Each	**$0.15**	**.17**	**.20**

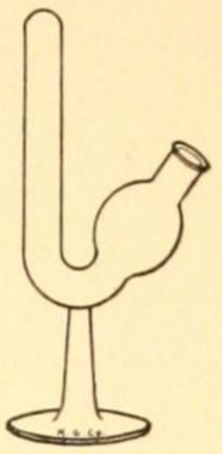
*905C. **Files, Triangular.** Slim taper, single cut, for cutting glass tubing, etc.

Lgth., in. (of cut portion only)	3	4	5	6
Each	**$0.10**	**.12**	**.13**	**.19**

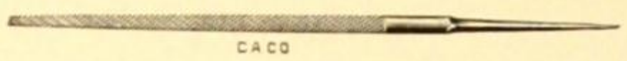
***20% discount in lots of 100.**



No. 896C.



No. 898C.

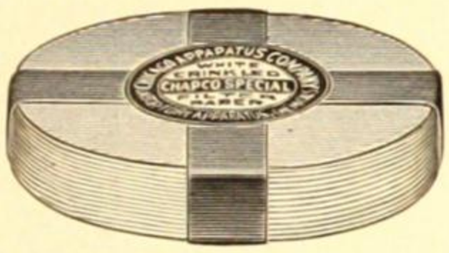


No. 900C.

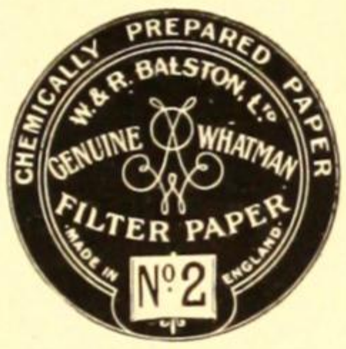


No. 905C.

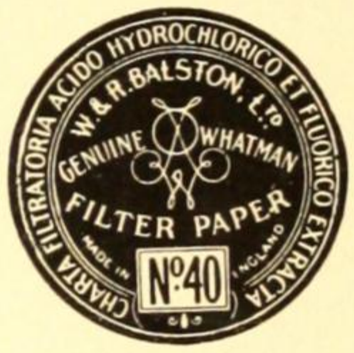
Filter Paper



No. 910C.



No. 915C.



No. 916C.

910C. Filter Paper, Milvay. A pure white paper of superior quality, strong and rapid, for qualitative work, 100 circles in a package. 20% discount in lots of 100 pkgs. of any one size.

Diameter, cm.	7.5	9	11	12.5	15	20	25	33
Per package	**$0.12**	**.15**	**.18**	**.20**	**.25**	**.42**	**.60**	**.90**

911C. Filter Paper, Milvay. Same quality as No. 910C, in sheets 20x20 inches.

Per quire (24 sheets)	**$ 0.60**
Per ream (500 sheets)	**8.00**

913C. Filter Paper, Whatman No. 1. For general qualitative work where ash weight is of no consequence. A high-grade rapid filter paper. Widely used in determination of phosphorus for the filtration of yellow ammonium—phospho-molybdate precipitate when obtained by long digestion as in fertilizer analysis. Also widely used in sugar laboratories.

Diameter, mm.	90	110	125	150	185
Ash weight per circle, grams	.0012	.00175	.0023	.00326	.00496
Per pack of 100	**$0.22**	**.25**	**.33**	**.46**	**.64**

914C. Filter Paper, Whatman No. 1. In sheets 18¼x22½ inches.

Per 100 sheets	**$ 4.00**
Per 500 sheets	**18.25**

915C. Filter Paper, Whatman No. 2. Similar to No. 1, but heavier. Retains fine precipitates and filters rapidly. Standard grade for analytical purposes. Especially well suited for use in qualitative analysis of the alkaline earths, and other work where fine precipitates of a crystalline nature are encountered. Also extensively used in fertilizer, steel and ore mining laboratories.

Diameter, mm.	90	110	125	150
Ash weight, per circle, grams	.0013	.002	.0027	.0038
Per pack of 100	**$0.31**	**.38**	**.47**	**.67**

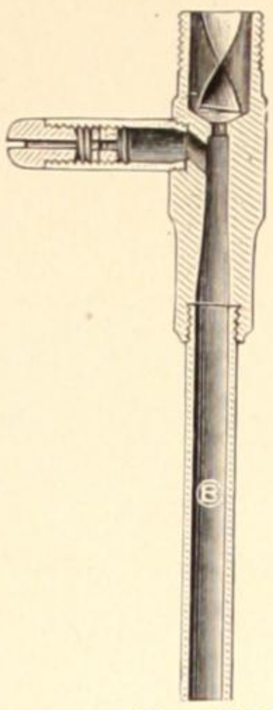
916C. Filter Paper, Whatman No. 40. Double-acid-washed. Treated by hydrochloric and hydrofluoric acid to extract all silicious matter. Very low ash weight, filters rapidly and retains fine precipitates. Recommended for general quantitative work.

Diameter, mm.	70	90	110	125	150
Ash weight, per circle, grams	.000046	.000076	.00011	.00015	.00021
Per pack of 100	**$0.95**	**1.35**	**1.60**	**1.85**	**2.15**

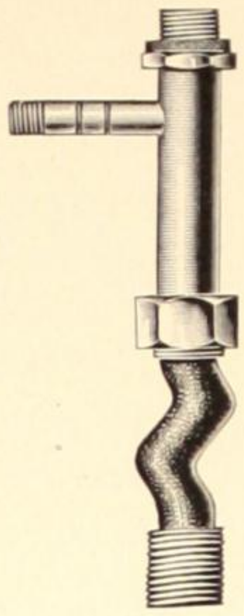
917C. Filter Paper, Whatman No. 42. Double-acid-washed. Similar to No. 40, but much harder and extremely close in texture. Recommended for use with vacuum and as folded filters where possible. Recommended for the same general quantitative purposes as No. 40, but especially for the finest precipitates that ordinarily are filtered with difficulty.

Diameter, mm.	70	90	110	125	150
Ash weight, per circle, grams	.000046	.000076	.00011	.00015	.00021
Per pack of 100	**$0.95**	**1.35**	**1.60**	**1.85**	**2.15**

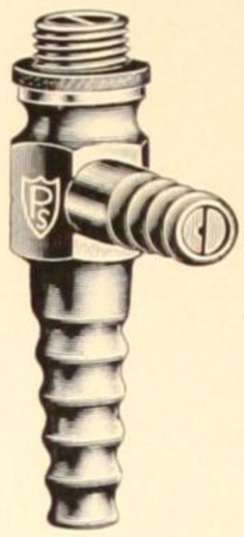
Filter Pumps



No. 918C.



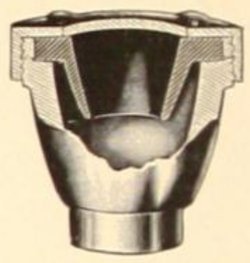
No. 920C.



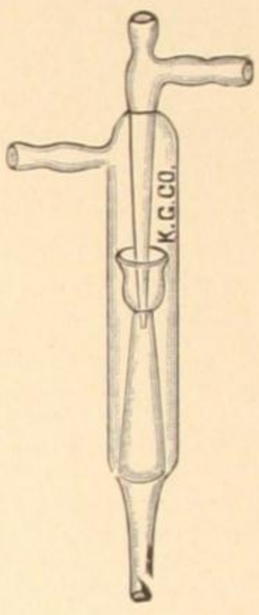
No. 923C.



No. 925C.



No. 930C.



No. 935C.

Note

Iron Pipe (I.P.) Thread Ratings. Threads cut on the outside of an iron pipe having an inside diameter or bore of ⅛ inch are designated as ⅛ inch I.P. threads. The actual diameter of such threads is the outside diameter of the iron pipe, which for ⅛-inch bore I.P. is ⅜ inch, ¼-inch I.P.—$\frac{11}{16}$ inch, ⅜-inch I P.—⅞ inch, and ¾-inch I.P.—$1\frac{1}{16}$ inches. Because filter pumps, couplings, and gas stopcocks are used on water and gas pipes they are rated in I.P. thread sizes.

918C. Filter Pumps. Aspirator. New design. Made entirely of brass. Will produce a higher vacuum in less time than the older forms.

Size	Small	Medium	Large
Length, inches	3¾	4¾	5⅜
Size, Iron Pipe Thread, inches	⅛	¼	⅜
Each	**$1.35**	**1.60**	**1.95**

920C. Filter Pumps. Richards. Of brass.

Size	Small	Medium	Large
Length, inches	7	7	13
Size, Iron Pipe Thread, inches	⅛	⅜	¾
Each	**$2.00**	**2.60**	**8.00**

923C. Filter Pump, Precision. A new design which, because of its unusual compactness and efficiency, is destined to ultimately replace all others. With water pressure at 35 lbs. and attached directly to a manometer, a vacuum up to 11 mm. can be obtained with water at temperature of 12° C. having a corresponding vapor pressure of 10.4 mm. so that a vacuum equivalent to 0.6 mm. is obtained. It will exhaust a desiccator of 6,500 cc. capacity to a vacuum of 14 mm. in 5 minutes and 19 seconds. It is made entirely from non-corrosive metals. Total length, 3¼ inches; threaded for ¼-inch iron pipe thread..... **$1.50**

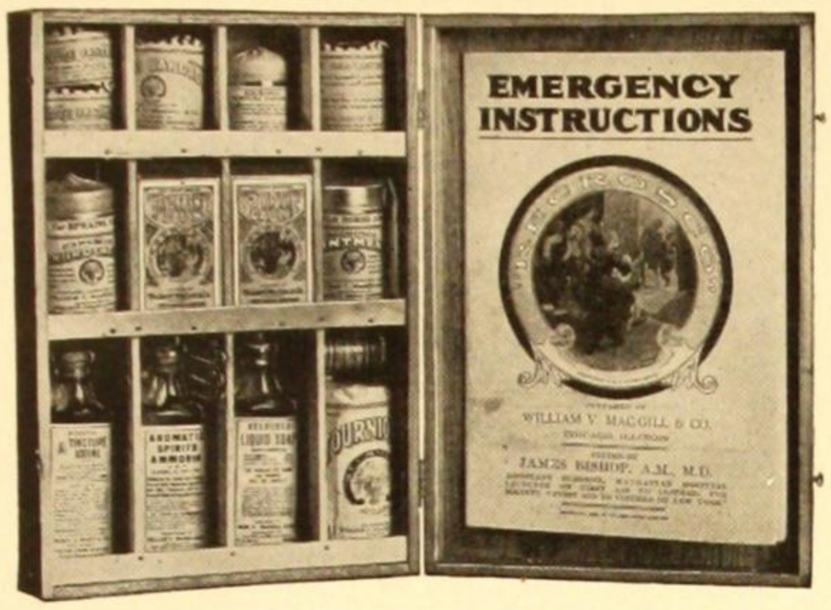
925C. Filter Pump Couplings. Brass, to connect Nos. 918C and 920C to threaded faucet.

Cat. No.	925C	926C	927C	928C
For Filter Pump with I. P. thread, inches	⅛	¼	⅜	¾
Each	**$0.40**	**.40**	**.40**	**.90**

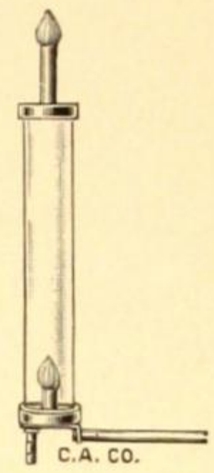
930C. Filter Pump Couplings. Brass, to connect Nos. 918C and 920C to smooth faucet.

Cat. No.	930C	931C	932C
For Filter Pump with I. P. thread, inches	⅛	¼	⅜
Each	**$0.60**	**.60**	**.60**

935C. Filter Pump, Glass. Muencke's..... **$1.80**



No. 1470B.



No. 941C.

941C. Flame Apparatus. For demonstrating that air will burn in gas exactly the same as gas burns in air, and that the size of the flame is regulated by the gas present in the smaller volume. Consists of a glass cylinder with fittings sealed air-tight to each end. The bottom one has inlets for gas and air—the top one an outlet for gas. When connected to gas supply, the gas escaping from the top may be ignited, while the air rushing through the bottom inlet may likewise be ignited, producing two flames as illustrated. A rod is attached to the lower fitting for convenience in attaching the apparatus to a laboratory stand.....**$5.00**

1470B. First Aid Cabinet. Designed for the laboratory, home, office, shop, etc. Invaluable in the prompt treatment of cuts, burns and bruises. A neat cabinet 12x8x3¼ inches deep containing: 4 Bandages (assorted), 1 pkg. Absorbent Cotton, ½ oz., 1 pkg. Styptic Gauze, 1 Tourniquet, 1 can Recrosco Ointment, 1 can Kapsikar Embrocation, 1 can Recrosco Dusting Powder, 1 yd. Adhesive Plaster, 2 oz. Aromatic Spirits Ammonia, 2 oz. Tinct. Iodine, 2 oz. Recrosco Liquid Soap, 1 doz. Safety Pins, pkg. Applicators, Envelope Hooks and Eyes to hang cabinet on wall. Complete with illustrated book of instructions.....**$6.00**

TECHNICAL DATA ON PYREX GLASS

PYREX is a trade-mark used on various low expansion borosilicate glasses and products which possess a combination of qualities rendering them superior in many respects to any glasses and products of similar type hereto available.

COMPOSITION—The simple chemical composition of the glass furnished for laboratory ware is an advantage as regards possible contamination of liquids in contact with it. It contains no metals of the magnesia-lime-zinc group and no heavy metals.

STABILITY—The method employed is that standardized by P. H. Walker for comparing the stability of glasses intended for laboratory purposes (Journal of the American Chemical Society, volume 27, page 865, 1905). Beakers of 250 cc. size with 150 cc. redistilled water were left in a steam bath for 48 hours, water being added to keep the volume constant. Our method differed from Walker in that Walker titrates the alkali in the resultingsolution while we evaporate the solution to dryness in a small platinum dish and weigh the total amount dissolved.

Repeated tests of PYREX laboratory ware in comparison with other high-grade ware on the market show average quantities dissolved:

PYREX	0.0002	American No. 1	0.0011
German	0.0011	American No. 2	0.0006

RESISTANCE TO SUDDEN COOLING—Our usual test is made by heating a 5 mm. glass rod in an electric furnace and then dropping the rod into cold water. The glass does not break when plunged by this method from 300° C to cold water.

SPECIFIC GRAVITY—2.25.

HARDNESS—The glass used in the manufacture of laboratory ware sold under the trade-mark PYREX does not commence to soften below approximately 800° C., that being the temperature at which a glass rod 1 mm. in diameter, suspended vertically, elongates of its own weight at the rate of 1 mm. per minute.

SPECIFIC HEAT—0.20.

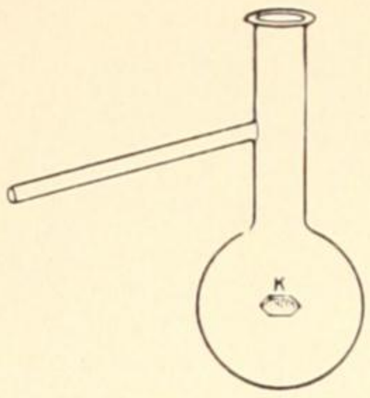
ELASTIC COEFFICIENT—6230 Kg. per Sq. mm.

THERMAL CONDUCTIVITY—0.0027.

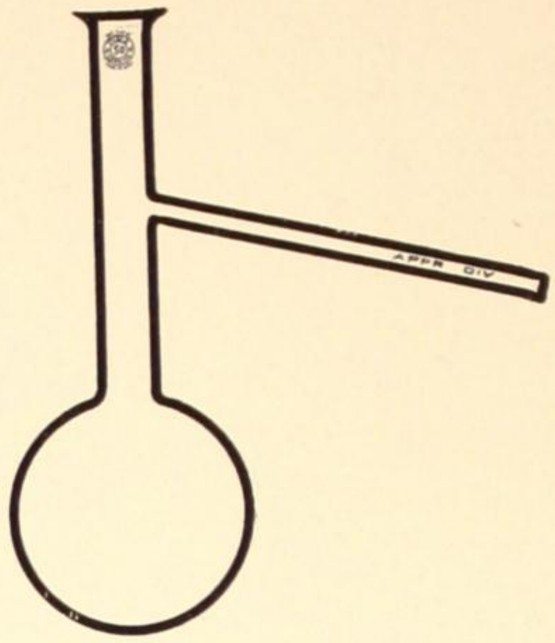
DIELECTRIC STRENGTH—20 Kv. per 100 Mil. Thickness.

LINEAR COEFFICIENT OF EXPANSION—.0000032 between 19-350° C.

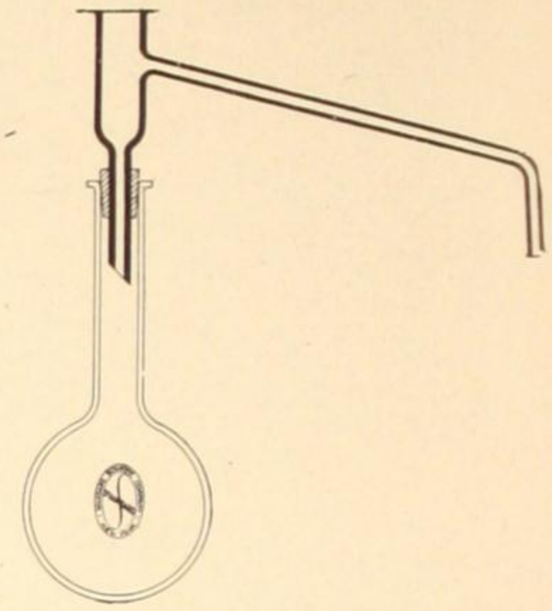
Flasks of All Kinds



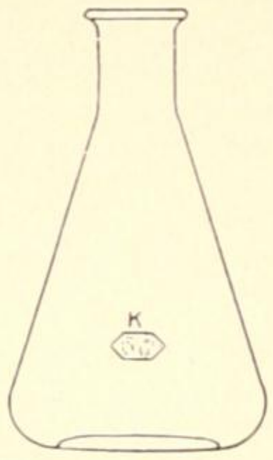
No. 942C.



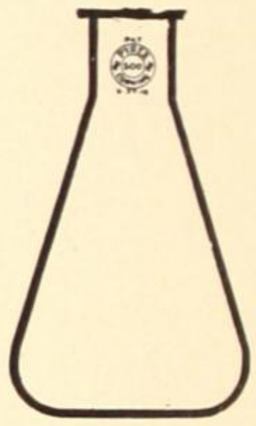
No .944C.



No. 12C.



No. 945C.



No. 950C.

942C. Flasks, Distilling, Resistant Glass. Regular shape, with side tube in middle of neck.
20% discount when ordered in original case.

Capacity, cc.	125	250	500	1000
Takes rubber stopper No.	3	3	5	5
No. in original case	40	40	30	20
Each	**$0.40**	**.50**	**.60**	**.95**

944C. Flasks, Distilling, Pyrex Glass. With side tube in middle of neck.
10% discount when ordered in original case.

Capacity, cc.	50	125	250	500	1000
Takes rubber stopper No.	1	3	3	4	6
No. in original case	24	24	24	18	12
Each	**$0.45**	**.55**	**.65**	**.75**	**1.20**

12C. Adapter, Distilling, Stansico. Designed to fit the ordinary flask for making distillations. It is connected to the flask by a rubber or cork stopper, forming a tight but rigid joint, thus lessening the liability of injury when used in the laboratory. Offers many advantages—flask may be easily removed for refilling without disturbing other connections—reduces shipping and handling breakage to a minimum—adapter may be transferred to other types of flask if desired—less costly than distillation flasks. With bent delivery tube and narrow stem. Price of adapter only, without flask or stopper **$0.60**

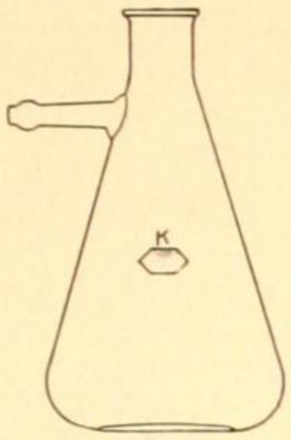
13C. Adapter, Distilling. Same as No. 12C, but with straight delivery tube and larger stem for inserting thermometer **$0.60**

945C. Flasks, Erlenmeyer, Resistant Glass.
20% discount when ordered in original case.

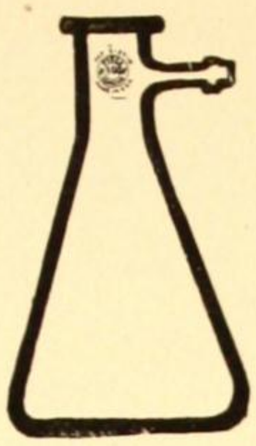
Capacity, cc.	50	125	250	500	1000
Takes rubber stopper No.	0	2	4	6	8
No. in original case	190	120	160	90	50
Each	**$0.15**	**.17**	**.20**	**.26**	**.36**

950C. Flasks, Erlenmeyer, Pyrex Glass.
10% discount when ordered in original case.

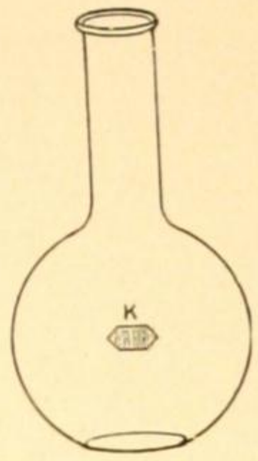
Capacity, cc.	50	125	200	250	500	1000	2000
Takes rubber stopper No.	1	3	5	5	6	8	10
No. in original case	120	180	144	132	72	36	24
Each	**$0.16**	**.18**	**.20**	**.22**	**.29**	**.42**	**.60**



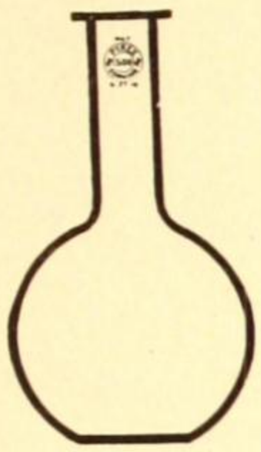
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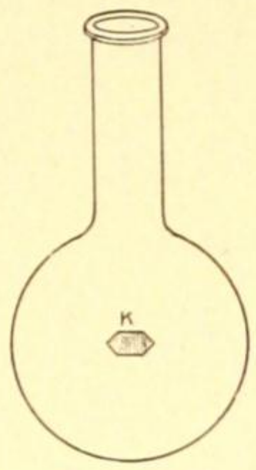
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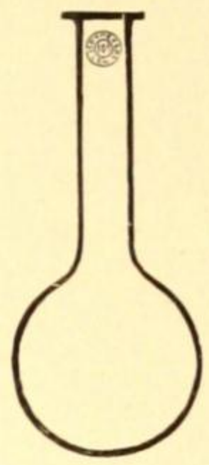
No. 950C.



No. 965C.



No. 970C.



No. 975C.

953C. Flasks, Filtering, Resistant Glass. Erlenmeyer Shape. Heavy wall, with side tubulation.
20% discount when ordered in original case.

Capacity, cc.	250	500	1000	2000
Takes rubber stopper No.	4	6	7	8
No. in original case	60	40	20	20
Each	**$0.65**	**.85**	**1.30**	**2.15**

955C. Flasks, Filtering, Pyrex Glass. Erlenmeyer Shape. Heavy wall, with side tubulation.
10% discount when ordered in original case.

Capacity, cc.	250	500	1000	2000
Takes rubber stopper No.	6	6	7	9
No. in original case	96	60	24	15
Each	**$0.70**	**.95**	**1.45**	**2.40**

960C. Flasks, Boiling, Flat Bottom, Resistant Glass. Vial mouth, uniform neck.
20% discount when ordered in original case.

Capacity, cc.	60	125	250	500	1000	2000
Takes rubber stopper No.	1	3	3	5	6	8
No. in original case	190	120	160	90	50	20
Each	**$0.15**	**.17**	**.20**	**.25**	**.35**	**.50**

965C. Flasks, Boiling, Flat Bottom, Pyrex Glass. Vial mouth, uniform neck
10% discount when ordered in original case.

Capacity, cc.	50	125	250	500	1000	2000
Takes rubber stopper No.	0	1	3	6	7	8
No. in original case	192	168	144	72	36	18
Each	**$0.17**	**.19**	**.24**	**.30**	**.43**	**.60**

970C. Flasks, Boiling, Round Bottom, Resistant Glass. Vial mouth, uniform neck.
20% discount when ordered in original case.

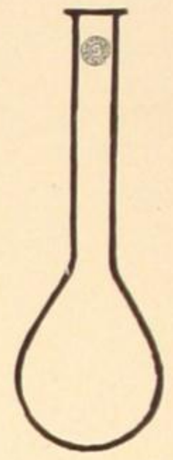
Capacity, cc.	125	250	500	1000
Takes rubber stopper No.	3	3	5	5
No. in original case	120	160	90	50
Each	**$0.17**	**.20**	**.25**	**.35**

975C. Flasks, Boiling, Round Bottom, Pyrex Glass. Vial mouth, uniform neck.
10% discount when ordered in original case.

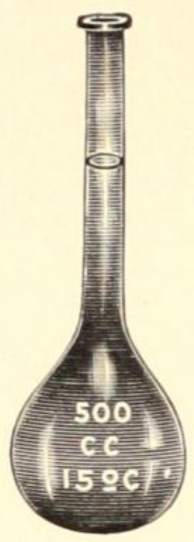
Capacity, cc.	100	200	300	500	1000	2000
Takes rubber stopper No.	2	3	4	4	6	9
No. in original case	84	144	84	48	30	18
Each	**$0.18**	**.22**	**.28**	**.37**	**.56**	**.79**



No. 976C.



No. 977C.



No. 980C.



No. 985C.

976C. Flasks, Round Bottom, Balloon Form, Pyrex Glass. With short ring neck.
10% discount when ordered in original case.

Capacity, cc.	200	500	1000	2000	3000	5000	12000
Takes rubber stopper No.	3	6	8	10	10	11	11
No. in original case	144	72	36	18	12	6	6
Each	$0.28	.38	.55	.78	.99	1.40	3.50

977C. Flasks, Kjeldahl. Pyrex Glass, long neck, round bottom, for digesting and distilling.
10% discount when ordered in original case.

Capacity, cc.	300	500	800
Takes rubber stopper No.	5	6	7
No. in original case	60	36	36
Each	$0.28	.37	.45

980C. Flasks, Volumetric. Glass, not stoppered, accurately graduated to contain.

Capacity, cc.	100	250	500	1000
Each	$0.45	.60	.75	1.00

985C. Flasks, Volumetric. Same as No. 980C, but with glass stopper ground in.

Capacity, cc.	100	250	500	1000
Each	$0.80	.90	1.10	1.45

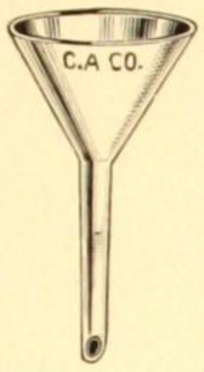


No. 990C.

990C. Forceps, Steel. Heavy, for general laboratory use.

Length, inches	5	6
Each	$ 0.15	.20
Per hundred	12.00	16.00

FUNNELS



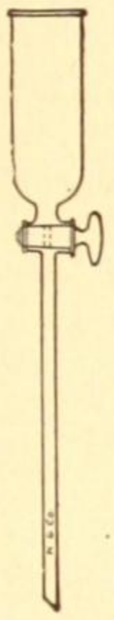
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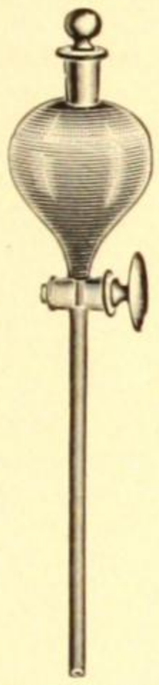
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No. 994C.



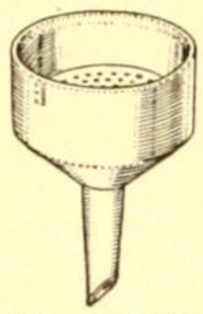
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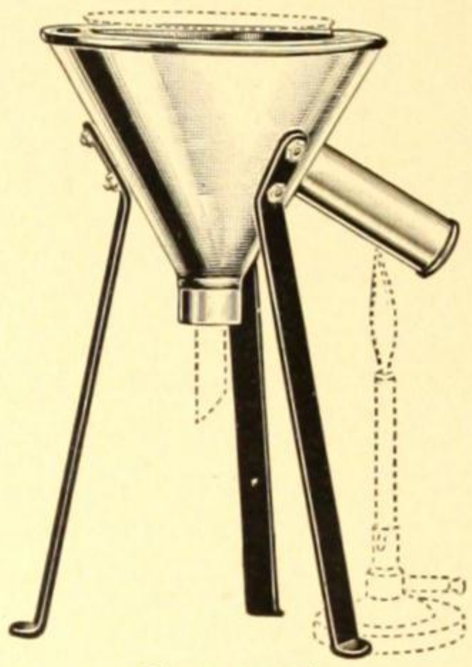
No. 1005C.



No. 1006C.



No. 1007C.



No. 1009C.

*991C. **Funnels, Glass, Chemical.** Angle 60 degrees, stem ground to a point. Suitable for filling purposes and students' qualitative filtration work.

Diameter, mm.	50	65	75	90	100	125	150	200	250
Length of stem, mm.	60	65	75	90	100	125	150	150	150
Each	**$0.20**	**.24**	**.28**	**.32**	**.36**	**.48**	**.60**	**.95**	**1.80**

*993C. **Funnels, Glass, Bunsen.** Mold-blown, with exact 60 degree angle and long, thin stems ground to a point and of such internal diameter as to induce rapid filtration. Rims are ground true.

Diameter, mm.	50	65	75	90	100
Length of stem, mm.	150	150	150	150	150
Each	**$0.27**	**.34**	**.38**	**.42**	**.50**

*994C. **Funnels, Glass Ribbed.** Designed for rapid filtering, of heavy molded glass, with smooth rim.

Diameter, mm.	120	145	180	220	255
Capacity, cc.	250	500	1000	2000	4000
Each	**$0.30**	**.45**	**.75**	**1.00**	**1.60**

***20% discount in lots of 50.**

†995C. **Funnels, Glass, Separatory, Cylindrical.** Open top, glass stopcock and long stem.

Capacity, cc.	60	125	250
Each	**$1.20**	**1.45**	**1.75**

†1005C. **Funnels, Glass, Separatory, Globe Shape.** Light glass, ground glass stopper, stopcock and long stem.

Capacity, cc.	30	60	125	250
Each	**$1.25**	**1.35**	**1.50**	**2.00**

†1006C. **Funnels, Glass, Separatory, Squibb's.** Pear-shaped, stopcock and ground-in stopper.

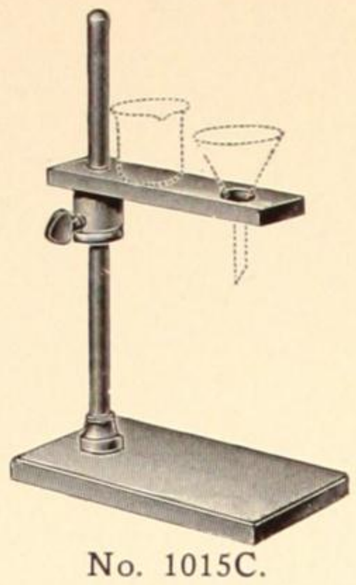
Capacity, cc.	125	250	500
Each	**$1.50**	**2.00**	**2.25**

1007C. **Funnels, Porcelain, Buechner's.** With stationary perforated plate and straight wall.

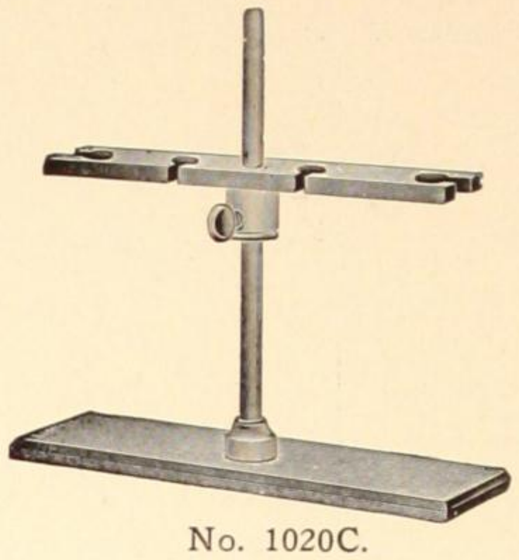
Diameter, mm.	66	82	102	122
Each	**$1.00**	**1.50**	**2.10**	**2.50**

1009C. **Funnel, Hot Water, Koch's.** Heavy copper, double walls, iron legs, inside diameter, 5½ inches. Without burner or glass funnel..... **$7.50**

†10% discount in lots of 12.



No. 1015C.



No. 1020C.

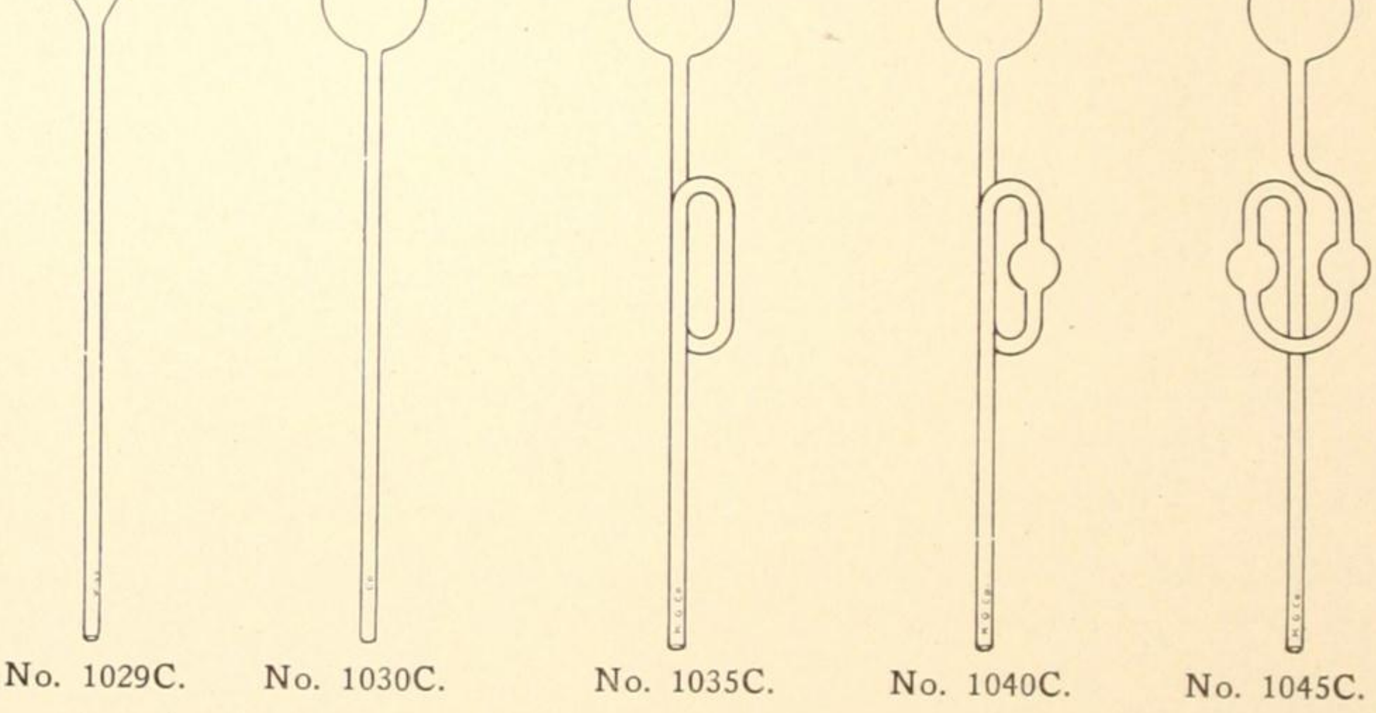


No. 1025C.

Funnel Supports

1010C. **Funnel Support, Hardwood.** For one funnel.....$0.75
1015C. **Funnel Support, Hardwood.** Same as No. 1010C, but with arm large enough to accommodate beakers $1.25
1020C. **Funnel Support, Hardwood.** For four funnels and with holes slotted so funnels can be removed from the side $1.35
1025C. **Funnel Support, Hardwood.** With holes for four funnels and iron clamp for attachment to support stand $0.60

Milvay Special Funnel Tubes



No. 1029C. No. 1030C. No. 1035C. No. 1040C. No. 1045C.

Extra strong funnel tubes, made from extra heavy selected glass tubing—not scraps. Stems are uniformly 6 mm. in diameter, and the wall thickness closely approximates 1½ mm. The funnel and thistle tops are extra heavy.

Milvay Special Funnel Tubes have been used for a number of years in the Chemistry Departments of many leading institutions, and have given such splendid satisfaction and have been so highly endorsed, that we have entirely discontinued the light weight styles heretofore considered standard.

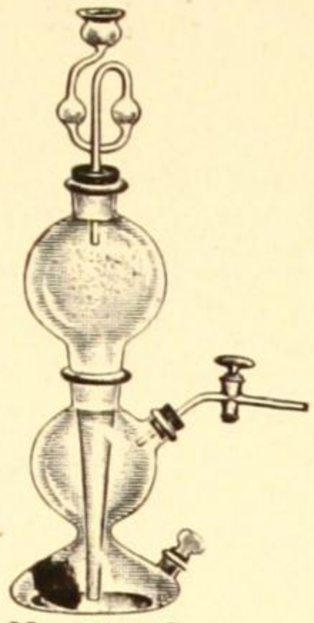
The slightly higher prices on Milvay Special Funnel Tubes cover only the additional cost of the extra weight of the glass tubing that enters into their construction.

*1029C. **Funnel Tube, with Conical Top.** Milvay Special; length, 30 cm. $0.18
*1030C. **Funnel Tube, with Thistle Top.** Milvay Special; length, 30 cm. ..... .18
*1031C. **Funnel Tube, with Thistle Top.** Milvay Special; length, 37.5 cm. ..... .20
*1035C. **Funnel Tube, Safety Type.** Milvay Special, with bend in stem, thistle top; length, 30 cm. ..... .30
*1040C. **Funnel Tube, Safety Type.** Milvay Special, with bend and bulb, thistle top; length, 30 cm. .... .40
*1045C. **Funnel Tube, Safety Type.** Milvay Special, "Gas Generator Type" with bend and two bulbs, thistle top; length, 30 cm. $0.45

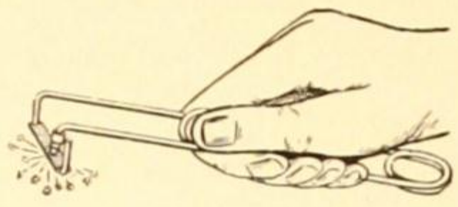
***25% discount in lots of 100.**



No. 1110C.



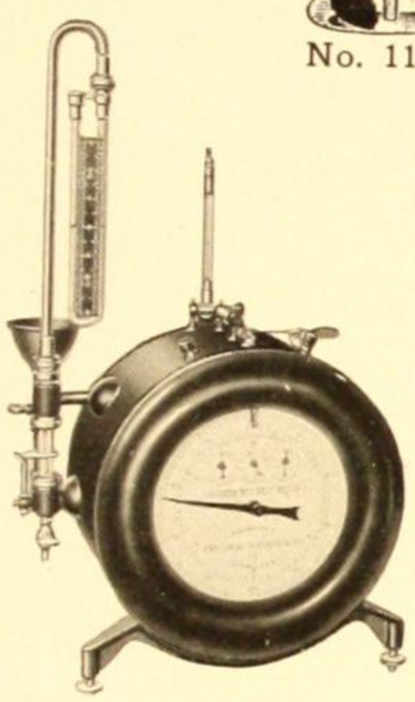
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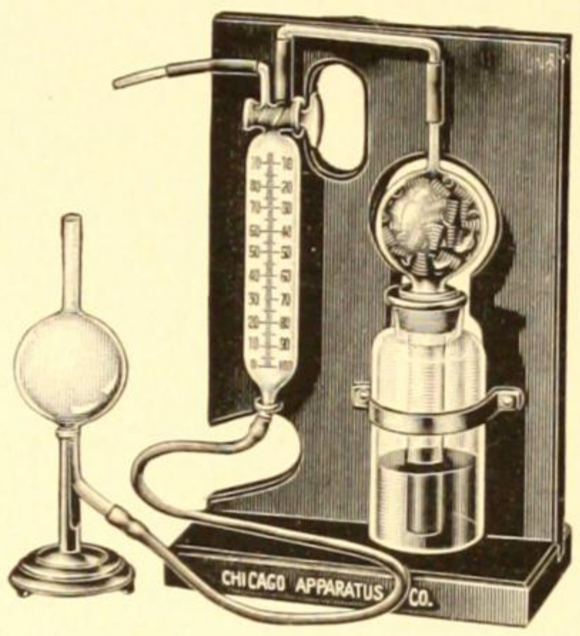
No. 1119C.



No. 1121C.



No. 6030C.



No. 1123C.

1110C. Gas Generating Bottle. For use in preparing hydrogen, carbon dioxide, and other gases. With two-hole rubber stopper, glass thistle tube and delivery tube. Capacity, 16 ounces **$0.75**

1114C. Gas Generators, Kipp's. Heavy glass, complete with safety funnel tube, glass stopcock and stoppers.

Cat. No.	1114C	1115C	1116C	1117C
Capacity, cc.	250	500	1000	2000
Each	**$6.75**	**8.00**	**10.00**	**12.50**

1119C. Gas Lighter. Will ignite any inflammable gas. A convenient lighter to replace matches in the laboratory. It is extremely easy to use and by friction of steel on flint produces a shower of sparks..... **$0.35**

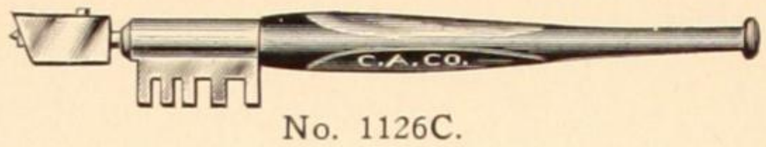
1120C. Gas Measuring Tube. Glass, graduated in 1/5 cc., without stopcock; capacity, 50 cc. **1.00**

1121C. Gas Measuring Tube. Glass, graduated in 1/5 cc.; capacity, 100 cc. **1.50**

6030C. Gas Meter, Wet Test, Precision. For the accurate measurement of gas in connection with laboratory determinations, such as moisture, dust, tar, calorific value, volume flow, etc. So precise and sensitive that accurate measurements of gas at pressures as low as $\frac{1}{10}$ inch of water are possible. The large indicator makes a complete revolution for each $\frac{1}{10}$ cubic foot, and the 100 divisions on the dial provide for direct readings to 1/1000 of a cubic foot. The three small dials record 1, 10, and 100 cubic feet respectively, which combination will record up to 1000 cubic feet. The instrument is fully equipped to control all operating conditions, so that standard measurements can be made and duplicated. The inside reservoir and revolving drum are made of brass, heavily tinned where in contact with water or gas. The body is finished in crystal black, the fittings in polished nickel plate..... **$85.00**

6035C. Gas Meter, Wet Test, Precision. Same as No. 6030C, but with all working parts of Monel metal **100.00**

1123C. Gas Tester, Ernest's. Designed by Dr. T. R. Ernest, Crane Junior College, Chicago, Ill. Provides a quick, simple, clean, direct method for determining the percentage of oxygen in air. Once charged, tests can be repeated until chemicals are exhausted. For this reason it is suitable for student as well as lecture work. Its use by students is excellent training for work with the more elaborate gas-analysis apparatus used in college and commercial work, the principle of which is much the same. In lecture work it is valuable for performing experiments introductory to the subject of gas analysis. Charged with the proper chemicals it is suitable also for measuring the per cent of Carbon Dioxide in flue gas and in the burned gas from Bunsen burners. The burette reads up and down and is graduated to 100 CC. in 1 CC. divisions. Therefore it indicates direct in volume and per cent. Complete as illustrated with chemicals for oxygen-in-air tests **$22.50**



No. 1126C.



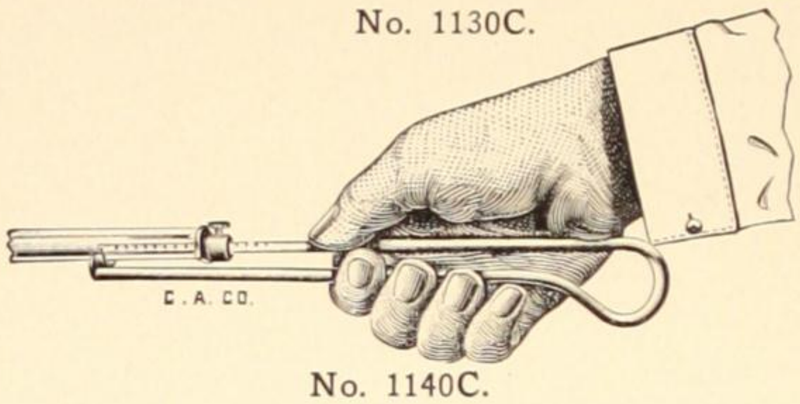
No. 1127C.



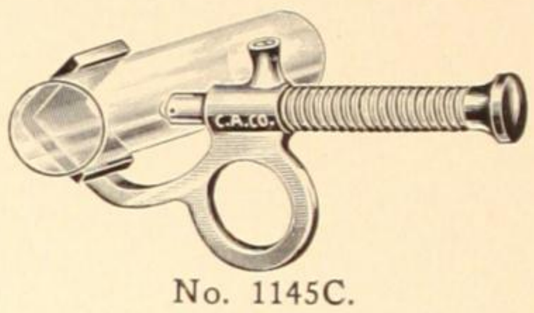
No. 1130C.



No. 1135C.



No. 1140C.



No. 1145C.



No. 1155C.

GLASS CUTTERS

1126C. Glass Cutter, Glazier's Genuine Diamond. For cutting or writing on glass. Finely finished handle, nickel-plated metal parts. Cuts single and double thick glass **$6.00**

1127C. Glass Cutter, Parker. For cutting glass by leading a crack in the desired direction. Copper head with four sharp edges, burner tube, large wood handle. Designed to operate on coal gas..... **$2.00**

1130C. Glass Cutter, Steel Wheel. Made entirely of steel, red finished handle, hand-honed cutting wheel, length, 4¾ inches **$0.20**

1135C. Glass Cutter, Steel Wheel. Nickel-plated head and ferrule, turret holder with six hand-honed wheels, rosewood finish handle, length, 5½ inches. Turret holder may be revolved on or clamped to the frame. The cutters are protected when not in position for use **$0.40**

1140C. Glass Cutter, Tubing. For cutting glass tubing. Steel, nickel-plated, adjustable guide with set screw, highest grade cutters, length, 11 inches. . **$1.20**

1145C. Glass Cutter, Tubing, Milvay. For cutting glass tubing 1 inch or less in diameter. This new model cuts better and truer because wheel cannot shift sidewise on the glass tubing. Pressure of cutter wheel is controlled by thumb pressure against hard rubber top of rod while glass tube is rotated in the V-groove. Made of brass with white nickel finish **$1.00**

1150C. Extra Cutting Wheels for No. 1145C. **Each** **$0.10**

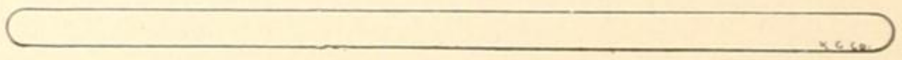
1155C. Glass Knife. For cutting glass tubing. Better than triangular files. Hardened steel, two-edge blade, hardwood handle. Total length, 8 inches. **$0.50**



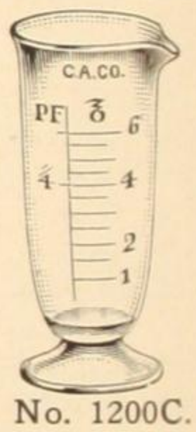
No. 1165C.



No. 1170C.



No. 1180C.



No. 1200C.

1160C. Glass Plates, Cobalt Blue. For flame tests.

Size, inches	2x2	2x3	3x3	4x4
Each	**$0.10**	**.14**	**.15**	**.20**

1165C. Glass Plates, Round. For covering beakers, jars, etc. Single thick window glass, edges not ground.

Diameter, inches	3	4	5	6	10
Each	**$0.08**	**.10**	**.14**	**.18**	**.65**

1170C. Glass Plates, Square. For covering beakers, jars, etc. Single thick window glass, edges not ground.

Size, inches	2x2	2½x2½	3x3	4x4	6x6
Each	**$0.04**	**.05**	**.06**	**.08**	**.10**

1175C. Glass Rodding. Best quality lead-free glass, in lengths of about five feet. Diameters are subject to the usual factory variations. In 5 pound quantities or more, glass rod is furnished in full lengths of about 5 feet. In smaller quantities, unless otherwise specified, half-lengths (about 30 inches long), convenient for packing, are usually furnished.

Diam., mm.	3	5	6	8	10
Approx. No. ft. per lb.	40	27	16	10	8
Per pound	**$0.80**	**.65**	**.65**	**.55**	**.50**

1180C. Glass Rods, Stirring. Both ends rounded.

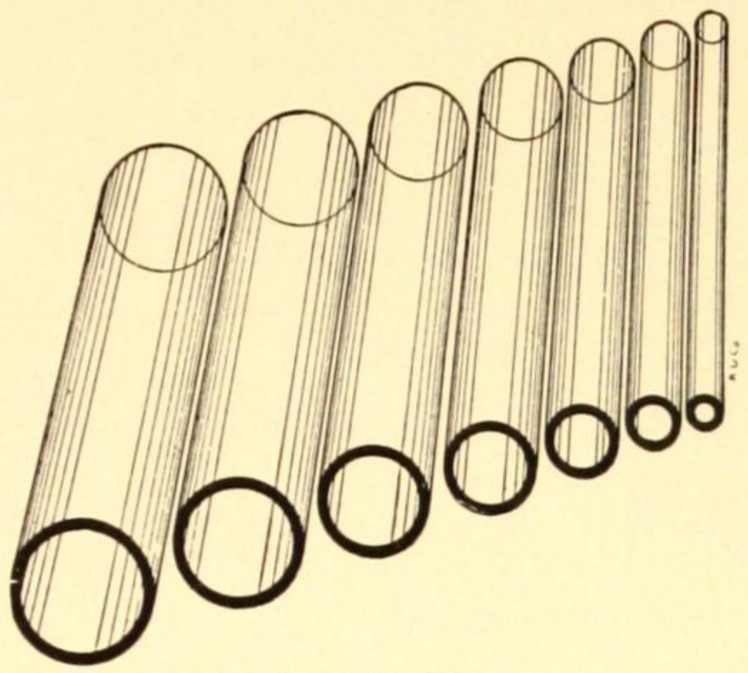
Length, inches	5	6	8	10
Diameter, inches	3/16	3/16	¼	¼
Per dozen	**$0.30**	**.35**	**.45**	**.55**

1200C. Graduates. Bureau of Standards, cone shape. Glass, graduated in ounces and cubic centimeters, double graduation.

Capacity, oz.	1	2	3	8	16	32
Capacity, cc.	30	60	100	250	500	1000
Each	**$0.65**	**.75**	**.90**	**1.50**	**2.25**	**3.50**

1201C. Graduation Filler. A white paste for restoring the graduations on used chemical thermometers, burettes, pipettes, graduated cylinders, etc., to their original appearance. Easy to use and very rapid. Just rub a small quantity over the graduated surface and wipe off the surplus with a piece of tissue paper. Dries in a few minutes. **Per 4-ounce jar**..... **$0.50**

Glass Tubing



No. 1185C.

1183C. Glass Tubing, Barometer. Heavy Wall; outside diameter, 6 to 10 mm. In 36-inch lengths.

Bore, mm.	3	4	5
Per pound	**$1.15**	**1.15**	**1.15**

1185C. Glass Tubing, Bending. Best quality soft glass, free from lead and especially adapted for glass blowing and bending. In lengths of about 5 feet. Diameters and thicknesses of wall subject to the usual factory variations. An extra charge is made for selecting tubing gauged accurately inside and outside. In quantities of 5 lbs. or more, tubing is furnished in full lengths—about 5 ft. long. In smaller quantities, unless otherwise specified, tubing is usually furnished in half-lengths (about 30 inches) convenient for packing. Orders for assorted tubing from 3 to 12 mm. must be for one pound or more; from 13 to 25 mm. for 2 lbs or more; from 25 to 50 mm. for 5 lbs. or more.

Diameter, outside, mm.	3	4	5	6	7	8	9	10	12	15	19
Thickness of wall, mm.	¾	¾	1	1	1	1	1	1½	1½	1½	1½
Approx. No. ft. per lb.	80	63	47	38	31	27	23	21	17	14	11
Price, per pound	**$1.10**	**1.10**	**.75**	**.75**	**.65**	**.65**	**.60**	**.60**	**.55**	**.50**	**.50**
Diameter, outside, mm.					22	25	32	35	38	47	50
Thickness of wall, mm.					1½	2	2	2	2	2	2
Approx. No. feet per pound					5	4	3	2½	2	1¾	1½
Price, per pound					**$0.55**	**.55**	**.60**	**.60**	**.72**	**.90**	**.90**

1187C. Glass Tubes, Annealed Ends. Glass tubes of large diameter are of little use unless the ends are annealed to prevent longitudinal cracking. We list below the sizes carried in stock for immediate shipment. The wall thickness is the same as No. 1185C glass tubing of corresponding diameter. The ends are cut square and thoroughly annealed.

No.	1	2	3	4	5	6	7	8	9	10
Diameter, outside, cm.	2.5	2.5	2.5	2.5	2.5	3	3	4	4	4
Length, cm.	30	60	75	100	150	100	120	45	60	100
Each	**$0.40**	**.65**	**.75**	**.85**	**.90**	**1.20**	**1.35**	**1.00**	**1.25**	**1.75**
No.		11	12	13	14	15	16	17	18	19
Diameter, outside, cm.		4	5	5	5	5	5	5	5	5
Length, cm.		110	20	30	38	60	75	90	120	150
Each		**$1.50**	**.80**	**1.25**	**1.35**	**1.45**	**1.75**	**1.90**	**2.75**	**3.25**

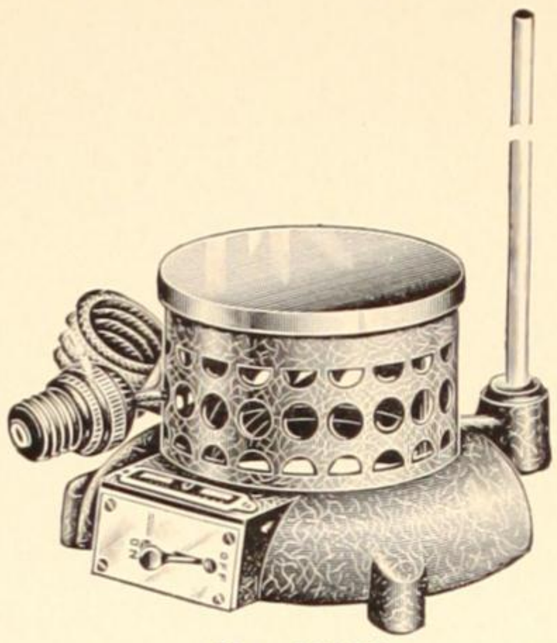
1190C. Glass Tubing, Capillary. From 5 to 7 mm. outside diameter. In lengths of about 5 feet. Approximate weight, per full length, 7 ounces.

Diameter of bore, mm.	¼	½	¾	1	1¼	1½	1¾
Per pound	**$1.10**	**1.10**	**1.10**	**1.10**	**1.10**	**1.10**	**1.10**

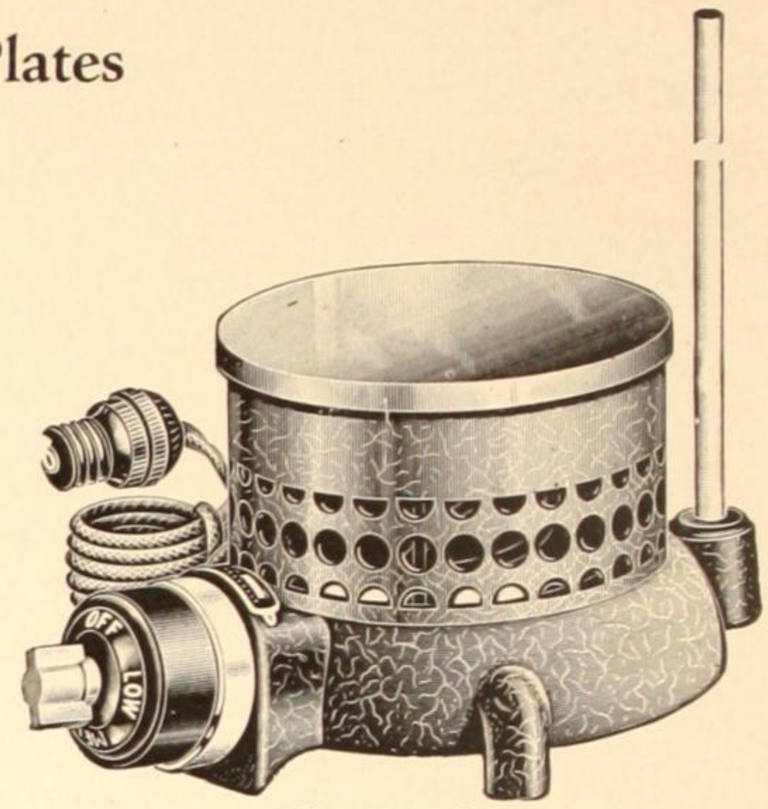
1195C. Glass Tubing, Combustion, Pyrex. Its high melting point, low coefficient of expansion and resistance to mechanical stress make it ideal for combustion work. In 36-inch lengths only.

Diameter, inside, mm.	5	6	7	8	10	12	15	18	21	25
Thickness of wall, mm.	.8	.8	1.0	1.0	1.2	1.2	1.6	1.6	1.6	2
Per pound	**$1.50**	**1.35**	**1.35**	**1.35**	**1.20**	**1.20**	**1.35**	**1.35**	**1.35**	**1.45**

Hot Plates



No. 6036C.



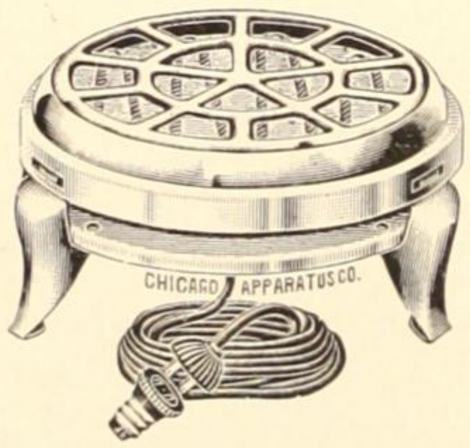
No. 6038C.

6036C. Hot Plate, Electric, Precision. Designed especially for hard laboratory use. Polished flat top, 4 3/16 inch diameter. Flat nichrome ribbon heating unit—imbedded to prevent oxidation and wound to give even heat distribution. Monel terminals and screws—corrosion proof. Switch placed so contents of flask, in case of breakage, will not run over it and ruin it. Crystallized black enameled base. Removable 20x3/8-inch nickel-plated rod fitted in leg at rear. An asbestos shield just below the heating element prevents downward radiation. Compact—occupies space of 6½x9½ inches. Besides other uses this plate is especially desirable for individual extraction work and saponification number on compounded oils. Consumes 300 watts. For use on 110 volts A.C. and D.C. circuits. With 6-ft. cord and plug **$9.50**

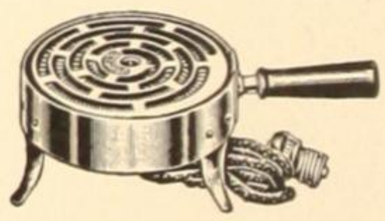
6037C. Hot Plate, Electric, Precision. Same as No. 6036C, but for use on 220-volt A.C. and D.C. circuits.. **$9.50**

6038C. Hot Plate, Electric, Precision. Same general design as No. 6036C, except with two ring heating units instead of one. An extra heavy asbestos disk, just below these units, prevents downward radiation. Being thoroughly imbedded, the life of these units is practically indefinite. The 3-heat switch is so placed that liquids spilled on the hot plate will not reach it and ruin it. The high heat obtainable makes this hot plate very desirable where quick boiling of liquids is required. Occupies space 7½x12¾ inches; polished flat top, 6 inch diameter; removable nickel-plated rod, 24x½ inch; consumes 660 watts; 6-ft. cord and plug. For use on 110 volts A.C. and D.C. circuits **$15.00**

6039C. Hot Plate, Electric, Precision. Same as No. 6038C, but for use on 220-volt A.C. or D.C. circuit.. **15.00**



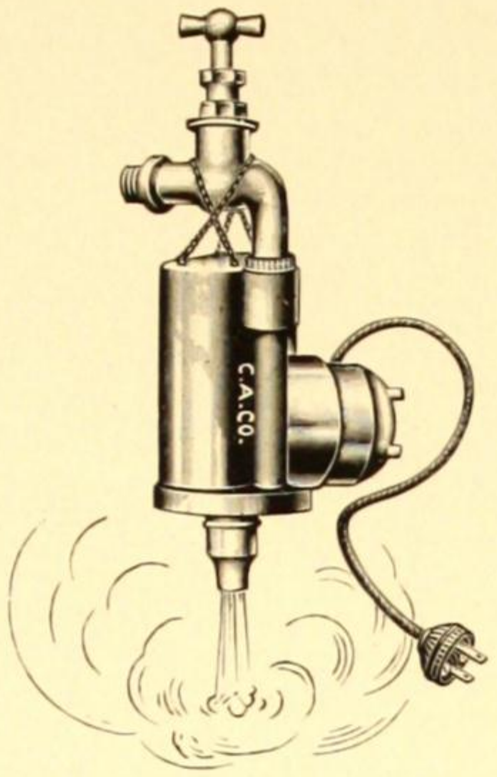
No. 1202C.



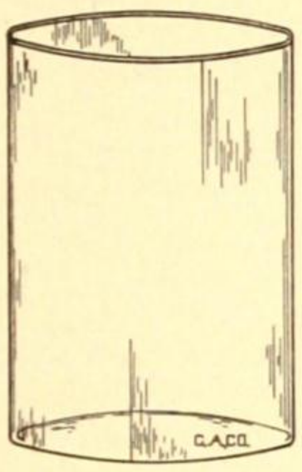
No. 1203C.

1202C. Hot Plate, Electric. Gives better satisfaction than many hot plates selling at two to three times the price. Useful in Chemical and Physical laboratories for operating steam generators (Apparatus "A") for boiling the contents of flasks and beakers, melting wax, heating solutions, etc.—in the Domestic Science laboratories for frying, toasting, percolating coffee, etc. Also useful in countless other ways where quick, constant, clean, focused heat is needed. Substantially constructed of metal and finished in bright nickel-plate. Provided with standard double plug, fitting any socket, and six-foot cord. Diameter of heating area, 5¼ inches; diameter overall, 6¾ inches. Operates on either A.C. or D.C. 110-volt circuits..... **$2.50**

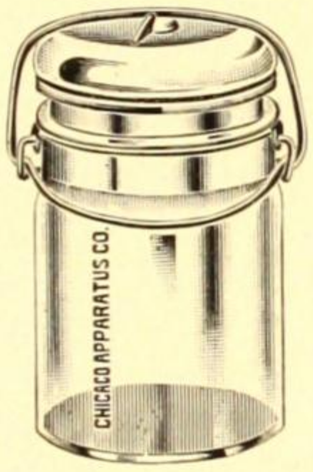
1203C. Hot Plate, Electric, High Heat. Produces an intense, concentrated heat for the rapid heating and boiling of solutions, etc. Has a porcelain nichrome element of simplified mechanical construction. The frame and legs are of pressed steel, nickel-plated. An added feature is the handle which permits moving the stove while it is hot. The Hot Plate stands two inches clear of the table and is supplied with a baffle plate heat deflector. The feet are insulated with fibre pads. Size, inches, 6½x6½x3⅝. Operates on either A.C or D.C. 110-volt circuits; current consumption 660 watts. Complete with six-foot cord with two-piece plug. A high-grade Hot Plate for long hard service **$4.00**



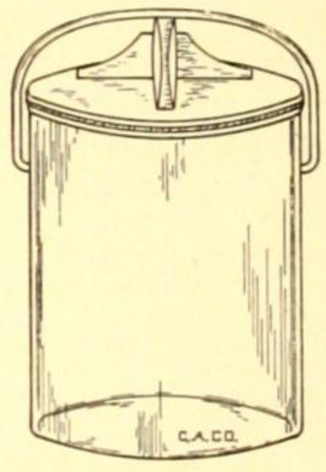
No. 75H.



No. 1205C.



No. 1210C.



No. 1212C.

75H. Hot Water Faucet Heater, Electric. Converts any cold-water faucet into an instantaneous hot-water source. In the laboratory such a source saves much time when used for filling steam generators, calorimeters, water baths, etc. Then too, it's a great convenience for washing beakers, flasks, funnels, jars, dishes, etc. It is very efficient. With cold water at a temperature of 50° F. it delivers 15 gallons per hour of warm water at a temperature of 85° F., 7.5 at 125°, 5 at 160°, or 3.75 gallons at 195° F.; and smaller amounts at boiling, or 212° F. It fits either threaded or smooth faucets and is easily and quickly installed. Made entirely of metal, very rugged, and finished in highly polished nickel plate. Current consumption, 10 amperes. For use on either 110-volt A.C. or D.C. with cord and plug **$15.00**

1205C. Jars, Battery. Round form, of light green glass.

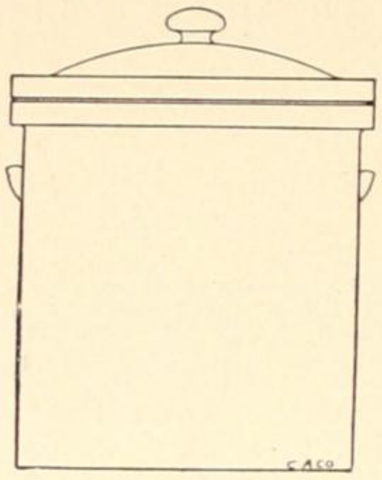
Cat. No.	1205C	1206C	1207C
Diameter, inches	4	5	6
Height, inches	5	7	8
Capacity, quarts	1	2	4
Each	**$0.45**	**.65**	**.85**

1210C. Jars, Specimen. With glass lid, rubber gasket and clamp.

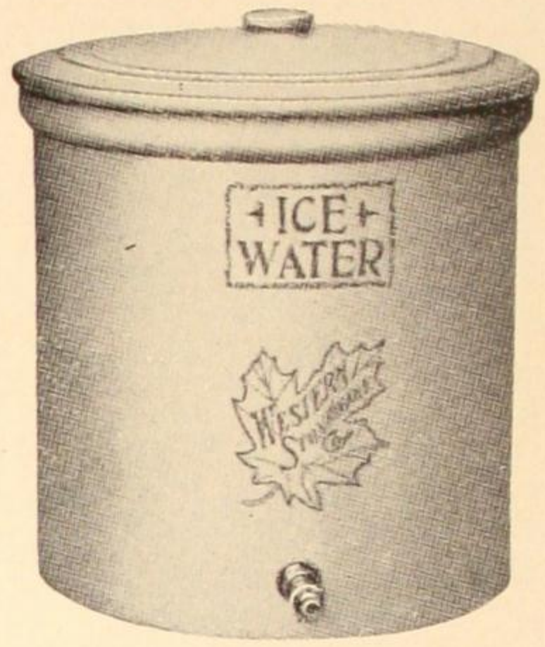
Cat. No.	1210C	1211C
Capacity, quarts	½	1
Per dozen	**$2.00**	**2.25**

1212C. Jars, Specimen. Of clear glass, with self-acting metal clamp. Body and mouth of same diameter, made air-tight by means of rubber ring.

Capacity, ounces	4¾	9	14	23
Height, inches	3½	5	6½	6
Diameter, inches	2½	3	3	4
Per dozen	**$2.70**	**3.60**	**4.80**	**6.60**



No. 1213C.



No. 1213CS.

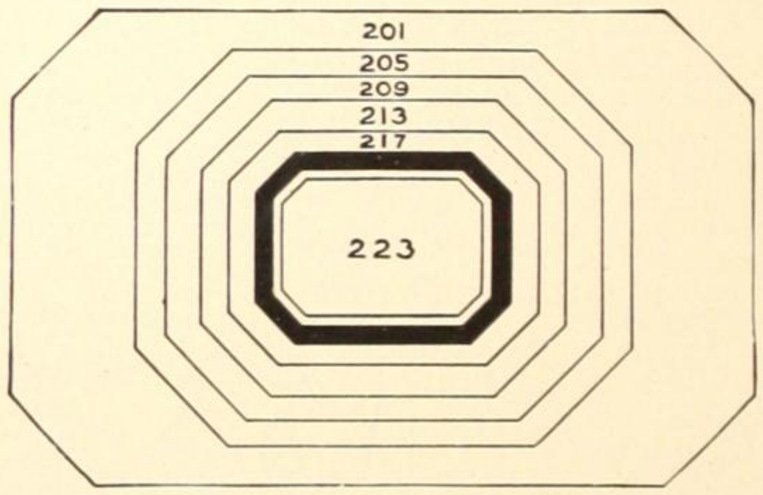
1213C. **Jars, Stoneware.** With handles and cover. For storing ordinary chemicals. Better than galvanized iron cans for refuse.

Our prices on stoneware jars include cost of boxing.

Capacity, gallons	1	2	4	6
Diameter, inches	6½	8¼	10¼	10¾
Height, inches	8	8¾	10½	13
Each	**$1.00**	**1.25**	**2.25**	**3.40**

1213CS. **Jars, Stoneware.** For storing distilled water, etc. Provided with cover and nickel-plated metal stopcock for drawing off water as needed. Our prices include cost of boxing.

Capacity, gallons	5	10
Each	**$5.50**	**9.00**



No. 1220C.

1214C. **Knife, Laboratory.** Round wood handle, four-inch steel blade. Excellent for cutting corks, etc.....**$0.30**

1215C. **Label Book.** Contains labels for the chemicals and reagents most commonly used in the chemical laboratory, each label bearing symbol in addition to name. Book contains about 500 labels, gummed, perforated, and arranged so that they may easily be removed without destroying the book **$0.75**

1220C. **Labels, Dennison's.** Gummed paper, rectangular shape, with red border, 100 labels in pasteboard box.

Size No.	201	205	209	213	217	219	223	259	261
Length, inches	2½	1⅝	1½	1¼	1⅛	1½	⅞	1⅜	2
Width, inches	1½	1⅜	1⅛	1	¾	¾	⅝	½	½
Per box	**$0.10**	**.10**	**.10**	**.10**	**.10**	**.10**	**.10**	**.10**	**.10**

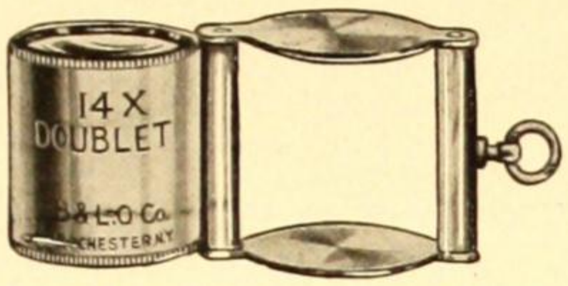
Size No.	2001	2002	2003	2004	2005	2007
Length, inches	3⅞	3⅞	4¾	2¾	4	2⅞
Width, inches	1½	1	2	1	1⅛	1⅝
Per box	**$0.25**	**.20**	**.35**	**.20**	**.25**	**.20**

1225C. **Matches, Safety.** In small boxes—2¼x1½x¾ inches. **Per dozen boxes** **$0.12**

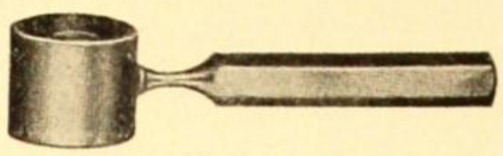
Magnifiers and Microscopes



No. 1850B.



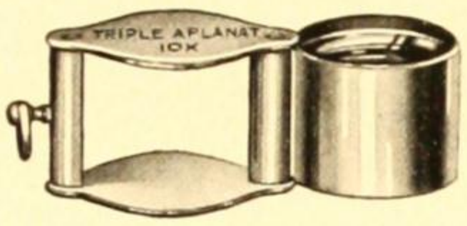
No. 1890B.



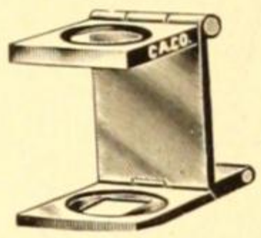
No. 1900B.



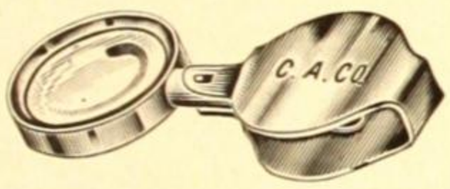
No. 1920B.



No. 1960B.



No. 1990B.



No. 2000B.



No. 2010B.



No. 2020B.

Magnifiers, Doublet. Recommended for use wherever a good lens is wanted at a reasonable cost. Consists of two separated plano convex lenses in three styles of metal mounting—dissecting, folding, or hand, as illustrated.

Cat. No.	Mounting	Magnification	Diam. of Field	Each
1850B.	Dissecting	7X	18 mm.	**$1.75**
1860B.	Dissecting	10X	16 mm.	**1.75**
1870B.	Dissecting	14X	10 mm.	**1.75**
1890B.	Folding	14X	10 mm.	**2.00**
1900B.	Handle	14X	10 mm.	**1.75**

Magnifiers, Triple Aplanats. The field of these magnifiers is large and has perfect correction for chromatic aberration, as well as for flatness, astigmatism and distortion. Recommended for the highest grade of work. Composed of two meniscus lenses of flint glass, separated by a double convex lens of crown glass, and are furnished in two styles of metal mounting—dissecting and folding.

Cat. No.	Mounting	Magnification	Diam. of Field	Each
1920B.	Dissecting	10X	20 mm.	**$5.75**
1930B.	Dissecting	15X	14 mm.	**5.75**
1960B.	Folding	10X	20 mm.	**6.00**
1970B.	Folding	15X	14 mm.	**6.00**

1990B. Magnifiers, Linen Tester. While intended primarily for use in counting the threads in cloth, they are employed also for a variety of purposes. The double convex lens is mounted at a distance above the base equal to its focal length, while an opening in the base exposes the object to be magnified. Both lens mount and base of brass are hinged to fold up compactly when not in use. Opening in base ¼x¼ inch, magnifying power 10X.....**$0.50**

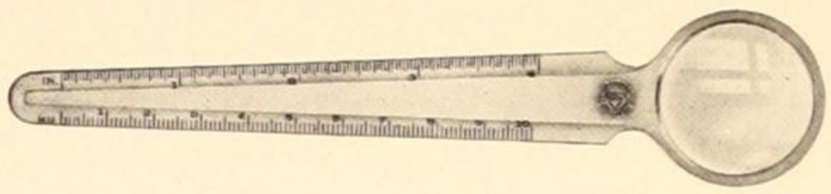
2000B. Magnifiers, Pocket. Nickel-plated metal mount, folding; good quality lens, 1-inch diameter, magnifying power 10X **$0.65**

Magnifiers, Pocket. Vulcanite mounting, highest grade lenses. Three different magnifications can be obtained with the double lens magnifier and seven with the triple lens magnifier.

Cat. No. 2010B	2020B	2030B
Number of lenses 1	2	3
Diameter of lenses, mm. 25	20-25	12-15-18
Magnifications 4X	4X to 8X	6X to 20X
Each **$0.75**	**1.00**	**1.60**



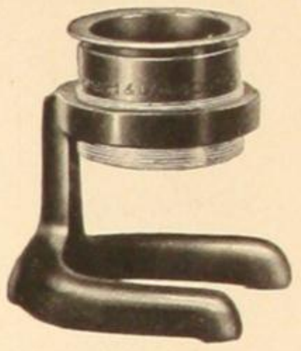
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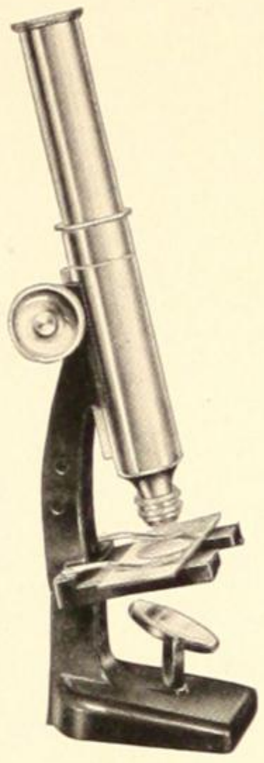
No. 2042B.



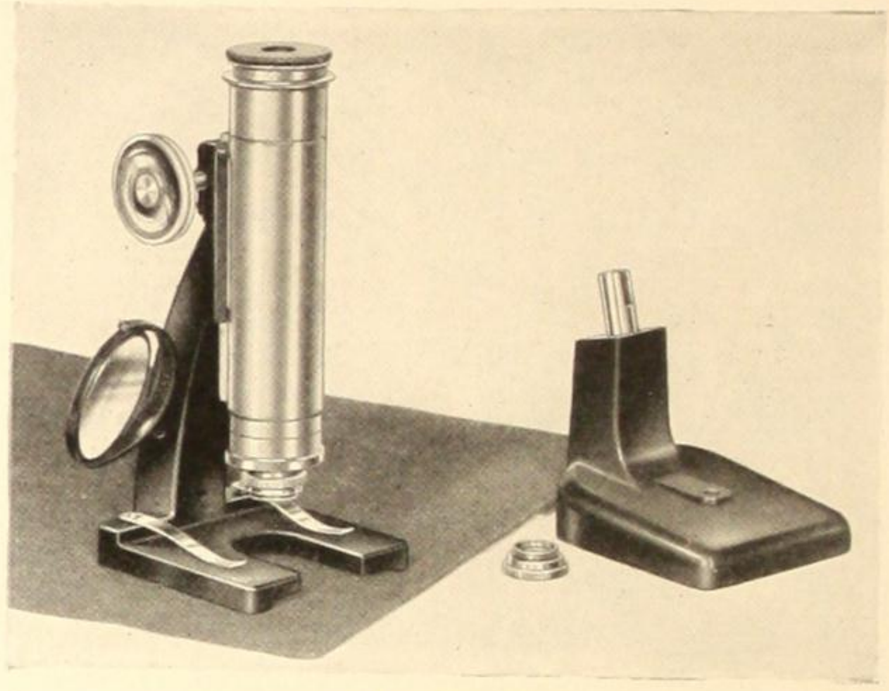
No. 2040B.



No. 2041B.



No. 2045B.



No. 2045B
(with base detached).

2035B. Magnifiers, Reading Glasses. Lenses are accurately ground and highly polished. Mounted in nickel-plated rims with ebonized wood handles.

Diameter, inches	2	2½	3	4
Equivalent focal length, inches	5	6	7	10
Each	**$0.75**	**.90**	**1.15**	**1.75**

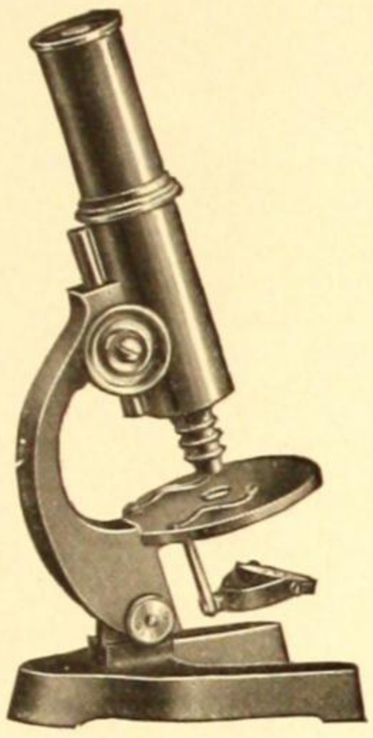
2040B. Magnifiers, Tripod. Of sufficient power for elementary biological work and because of its large, clear field is quite widely used for dissections. Consists of two double convex lenses, separated by a diaphragm, in a mounting which screws up and down in the metal frame for focusing. Diameter of lenses 1 inch, magnifying power 7.5X **$0.80**

2041B. Magnifier, Utility. This is a splendid substantial instrument for Biological use and will be found far superior to the ordinary tripod magnifier. Its achromatic objective is finely corrected affording a flat, sharply defined field of view. The optical system is threaded for focusing and screws into the sturdy black enameled horseshoe base. It is an ideal magnifier where extreme compactness and portability are not required. Lens diameter 35 mm. Power 4½X **$8.50**

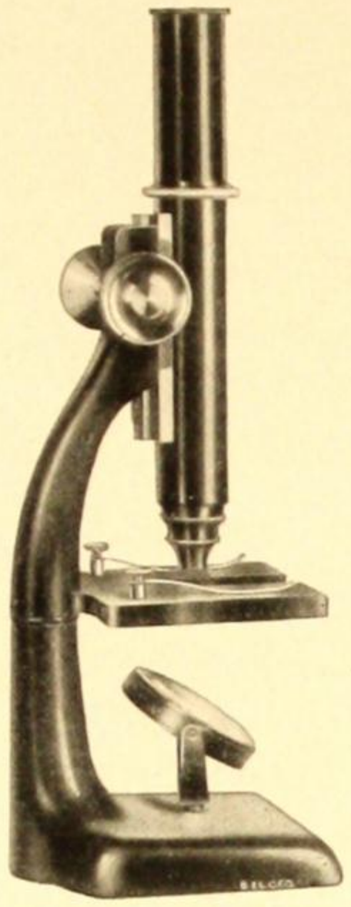
2042B. Pocket Magnarule. The Magnarule is an attractive and very useful instrument for the vest pocket, handbag or desk. To slit the uncut pages of a new book, to open letters, to take small measurements, or to magnify detail not readily discernible with the unaided eye, are a few of the many ways that it may be made to serve **$1.00**

2045B. Microscope, Little Gem. An inexpensive American-made microscope with new features. With it you have the two-fold advantage of being able to examine small objects on a card or glass slide, or by detaching the base any portion of a large object, such as cloth or a leaf, by placing the instrument directly on the object to be examined. To strongly illuminate the object, the mirror, which is easily detached from the base, may be secured in one of two holes in the arm and the light reflected downward. May also be employed to good advantage as a demonstration microscope in classroom lecture work. Because of the higher quality of the lenses used, the Little Gem offers a large, sharp, clear field that is free from color fringes and in the low powers gives a field of $\frac{5}{16}$ of an inch.

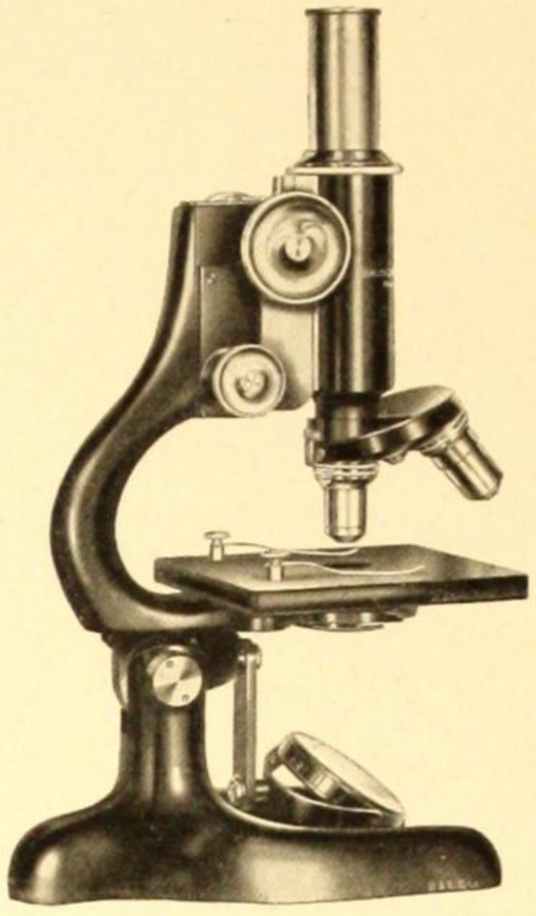
A wide range of magnifications may be procured. With the tube extended it is possible to get as high as 300 diameters. With the tube contracted and with the top of the objective removed, 75 diameters. Many objects can be seen effectively with the low or medium powers. Any standard objective may be substituted for the objective provided, thus enlarging the usefulness of this valuable instrument.... **$18.00**



No. 2055B.



No. 2070B.



No. 2071B.

2055B. Microscope, Compound, Student. Meets all students' requirements for laboratory work in Biology, General Science and Physiology. The objective has three lenses and is divisible. Two eyepieces are supplied, 4X and 5X. This provides six different magnifications ranging in power from 40X to 200X. Adjustment is by standard rack and pinion. The mirror is adjustable to any desired position. Stand has inclination joint and provided with an improved horseshoe base. Circular stage with nickel-plated slide clips. Complete in polished wood case..**$22.50**

2070B. Microscope, Compound. Bausch & Lomb Model AA. This improved AA microscope with the standard 5X ocular and 7.5X-15X divisible objective giving magnifications of 37X and 75X is especially suitable for teaching elementary Biology. Should higher magnifications be required, a 10X ocular can be used giving 75X and 150X magnifications respectively. This microscope succeeds the old Bausch & Lomb Model "A" Microscope. Just as the "A" of the catalog designation has been doubled to distinguish the improved model, so has the usefulness of the instrument also been doubled, for the changed construction allows the base to be detached. Two uses for the scope are found, therefore, where one existed before; transparent specimens mounted on glass slides can be examined with the complete instrument, while with the base detached the surfaces of opaque objects may be studied. (In this respect the AA Microscope is similar to the "Little Gem" Microscope, our No. 2045B, and may be used as illustrated for the "Little Gem" Microscope.)

When the base of Microscope AA is detached, the body may be placed directly on a large opaque object or surface to be examined. The mirror may be inserted in the hole above the stage for incident illumination of the specimen.

When the body and base are assembled, Microscope AA becomes an excellent instrument for the examination of transparent specimens mounted on glass slides. The mirror is then below the stage for trans-illumination of the specimen.

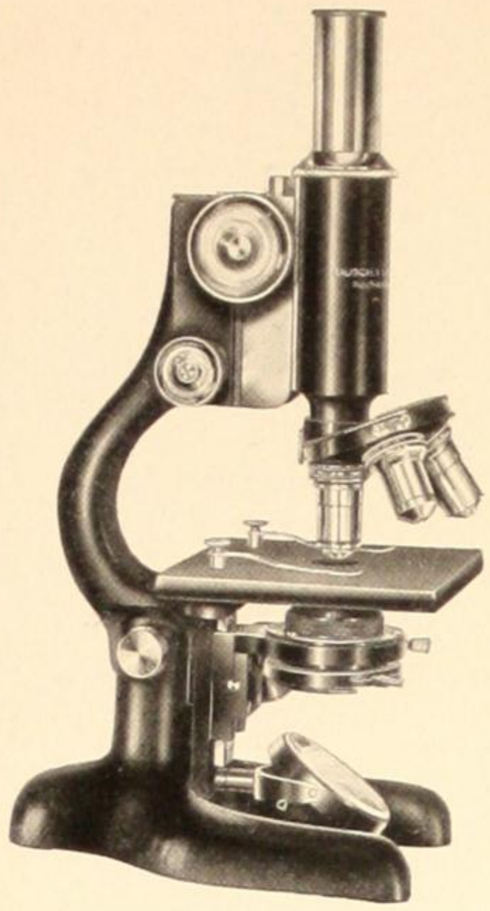
This microscope is focused by a rack and pinion adjustment.

It is furnished with divisible objective, complete in carrying case **$29.50**

2071B. Microscope, Compound. Bausch & Lomb Model FS2. This microscope is admirably adapted for laboratory work in botany, physiology and zoology. It has a fixed tube length of 160 mm., giving invariably the right distance between eyepiece and objective. The fine adjustment is the original "automatic take-up for wear" type, operated by a milled head on the side of the curved handle arm and ceasing to act when objective touches slide; coarse adjustment is by rack and pinion, with stop to prevent pinion from overriding rack. A brass block on top of arm makes it impossible to rack objective down against the iris diaphragm; the latter is operated by a knurled ring beneath the stage. The stage is completely covered with vulcanized rubber.

The optical parts are of highest quality, and objectives, adjustment heads, etc., are triple chromium plated. A double mirror, plane and concave, is adjustable in two planes and mounted on a swinging arm. The stand has inclination joint with stops. The finish is reagent and alcohol-proof; the case of hardwood, with brass lock and key. Complete with (43X) and (10X) dry, long-working distance objectives, 7.5X eyepiece, and circular double nosepiece. Magnifications, 75 and 322 diameters...**$71.75**

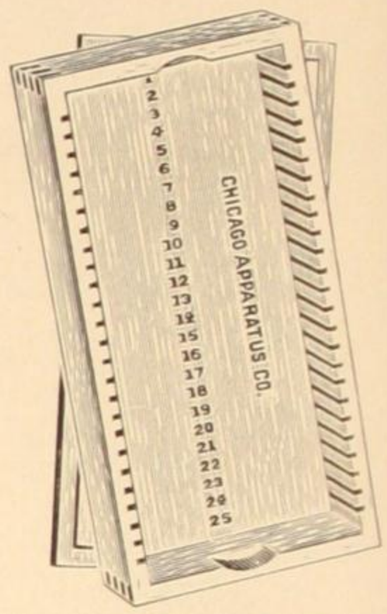
2072B. Microscope, Compound. Bausch & Lomb Model FS4. Same as No. 2071B, but with 4 mm. (43X) and 16 mm. (10X) long-working distance objectives, 5X and 10X eyepieces and circular double nosepiece. Magnifications 50, 100, 215 and 430 diameters **$74.50**



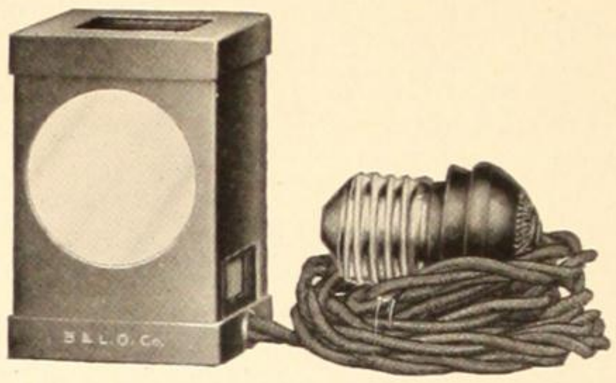
No. 2075B.



Nos. 2220B-2230B.



No. 2280B.



No. 2170B.



Nos. 2250B-2260B.



Nos. 2255B-2265B.

2075B. Microscope, Compound. Bausch & Lomb Model FFS8. This microscope gives the finer resolution and higher magnifications necessary for bacteriological work, and is provided with patented side fine adjustment. A complete rotation of the micrometer heads on either side of the arm produces a vertical movement of 0.25 mm., always in the same direction as the coarse adjustment heads, and ceasing to operate when objective touches slides.

The stage is completely covered with vulcanized rubber and fitted with a substage, in which the Abbe Condenser is focused by a quick-acting screw. A draw tube is provided, graduated in single millimeters, with every tenth line numbered. The coarse adjustment is by rack and pinion, with stop to prevent pinion from overriding rack. The optical parts are of highest quality, including an oil immersion objective for highest power work, and objectives, adjustment heads, etc., are triple chromium plated.

The stand has inclination joint, with horizontal and vertical stops. The finish is alcohol and reagent-proof; the case of hardwood, with brass lock and key. Complete with 4 mm. (43X) and 16 mm. (10X) long-working distance dry objectives; 1.9 mm. (97X) oil immersion objective; 5X and 10X eyepieces; 1.20 N. A. Abbe Condenser with lower iris diaphragm; and circular triple nosepiece. Range of magnifications 50 to 970 diameters **$120.00**

2076B. Microscope, Compound. Bausch & Lomb Model FFS10. Same in every detail as No. 2075B, but with 1.8 mm. (100X) fluorite oil immersion objective in place of the usual 1.9 mm. achromatic objective. The fluorite objective gives greater refinement in definition and a slightly higher magnifying power. Range of magnifications 50 to 1,000 diameters..... **$133.00**

2170B. Micro Lamp, Substage. Bausch & Lomb. New design which immediately commends itself because of its unusual compactness and efficiency. The complete outfit is placed underneath the microscope stage, the mirror being turned aside so that the lamp sends its rays directly to the specimen. If desired, the lamp can be used equally well in front of the microscope with the light directed to the mirror in the usual way.

The illuminant is a 15-watt Mazda lamp, 110 volts, D.C. or A.C., connecting with any house socket. The housing, entirely of metal, has double ventilated sides and top. The deep-curve reflector fixed behind the lamp bulb intensifies the illumination. Complete with blue and ground glasses, 5-foot cord and plug **$5.50**

2180B. Micro Lamp, Substage, Bausch & Lomb. Same as No. 2170B, but with Corning Daylight Glass in place of blue and ground glasses. Gives a light, when used with the Mazda lamp, approximately that received from a white cloud. Renders true colors of stains and specimens, as seen by natural light.... **$6.50**

2190B. Lamp. Bulb only, 15-watt, 110-volt..... **1.25**

2220B. Micro Slides, Non-Corrosive, Medium Thick. Of hard glass, slightly greenish tint when viewed edgewise. Guaranteed against corrosion in any climate. With well-ground edges and of fair uniformity in thickness. We recommend this slide for general laboratory work of all kinds. Size 3x1 inch. Packed in ½-gross cartons. **Per gross** **$1.75**

2230B. Micro Slides, Extra Thin, White Glass. The best slides obtainable of a pure white glass. Uniform thickness, with edges well ground. Size 3x1 inch, packed in ½-gross cartons. **Per gross**.... **$2.25**

2250B. Micro Coverglasses, Non-Corrosive, No. 1 Thickness. (1/150 to 1/200 inch, .13 to .17 mm.), best white glass. Packed in ½-ounce boxes:

Cat. No.	2250B	2251B	2255B	2256B
Shape	Round	Round	Square	Square
Size, inches	¾	⅞	¾x¾	⅞x⅞
Size, mm.	18	22	18x18	22x22
Approximate number per box	280	180	200	150
Per ounce	**$1.75**	**1.75**	**1.50**	**1.50**

2260B. Micro Coverglass, Non-Corrosive, No. 2 Thickness. (1/100 to 1/150 inch., .17 to .25 mm.), best white glass. Packed in ½-ounce boxes.

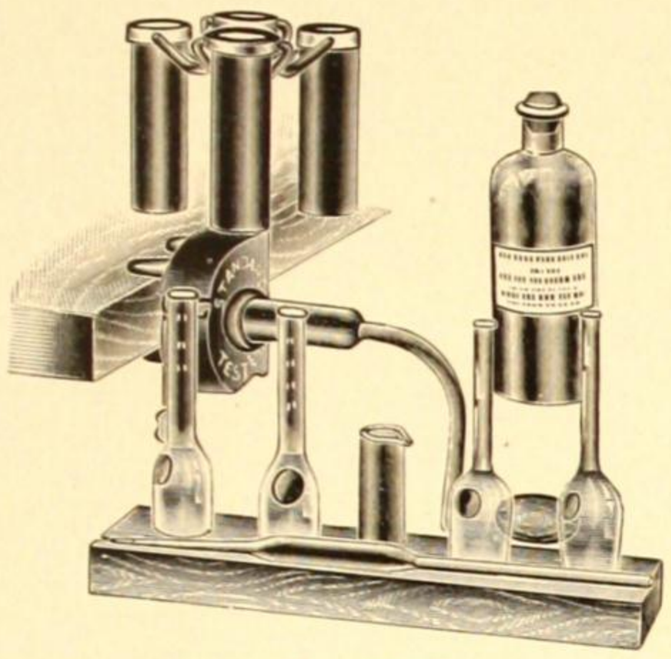
Cat. No.	2260B	2261B	2265B	2266B
Shape	Round	Round	Square	Square
Size, inches	¾	⅞	¾x¾	⅞x⅞
Size, mm.	18	22	18x18	22x22
Approximate number per box	195	155	160	120
Per ounce	**$1.50**	**1.50**	**1.20**	**1.20**

2270B. Micro Slide Box. Capacity, 100 standard 3x1-inch slides. Cover is hinged and fitted with catches. Made of wood and cardboard finished in black. Provided with index and register **$1.00**

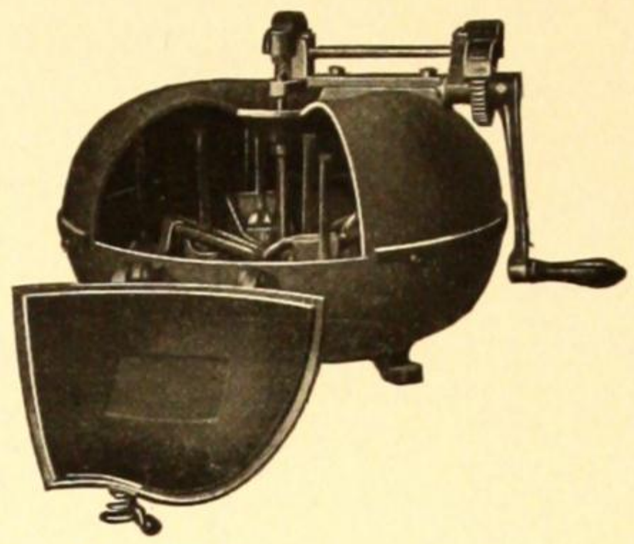
2280B. Micro Slide Box. Capacity, 25 standard 3x1-inch slides. Made of light wood with snug-fitting cover. Provided with index and register..... **$0.15**

2290B. Micro Slide Labels. For use with Nos. 2220B to 2242B micro slides. Gummed paper, 22x22 mm., 100 in a box. **Per box**..... **$0.15**

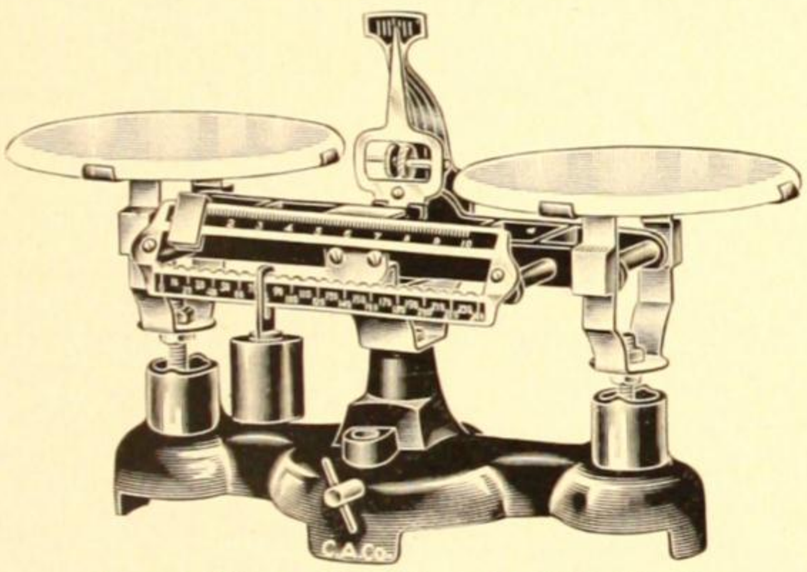
Milk and Butter Testing Apparatus



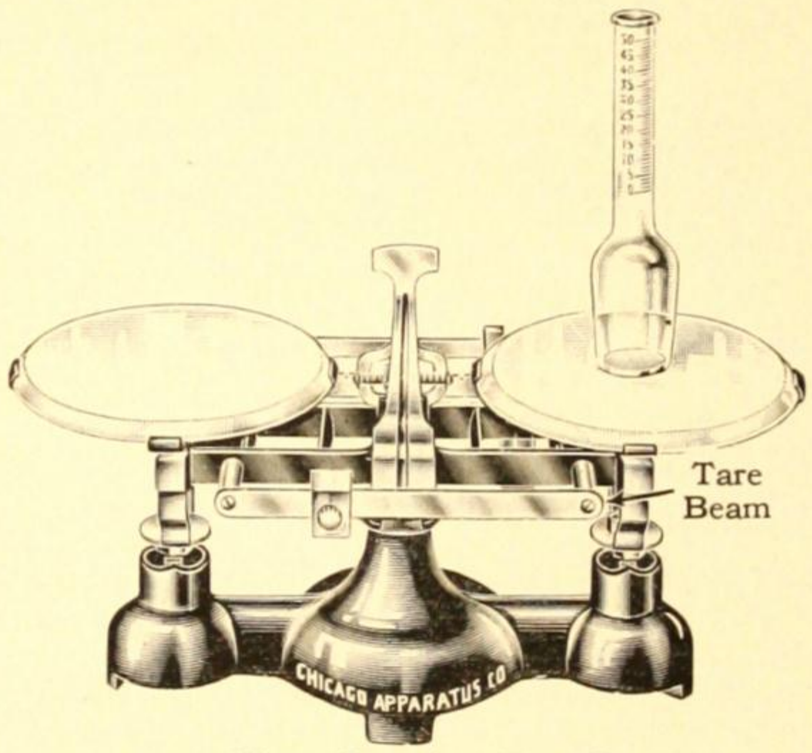
No. 2430B.



No. 2440B.



Front View, Showing Double Beam.



Back View, Showing Tare Beam.

No. 171B.

2420B. Babcock Milk and Cream Testers, Open Type, Two Bottle. Ideal for school room as well as for practical use. Has enclosed cut steel spiral gears which run in grease without noise. Operates very easily without jars or vibrations. Can be clamped to any bench or table. The seamless brass pockets cannot come off during rotation. Complete with two milk test bottles, two cream test bottles, one combined pipette, one acid measure, bottle for acid, brush for cleaning test bottles, and full directions for use **$9.00**

2430B. Babcock Milk and Cream Testers, Open Type, Four Bottle. Same as No. 2420B, but with four swinging brass pockets, four milk test bottles, two cream test bottles, one combined pipette, one acid measure, bottle for acid, brush for cleaning test bottles and full directions..... **$10.00**

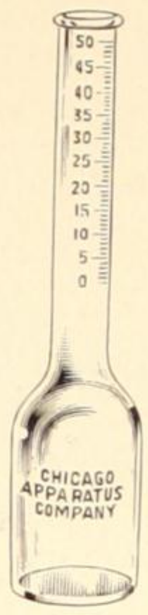
2440B. Babcock Milk Testers, Enclosed Type. Enclosed in iron case with hinged cover. Cut steel spiral drive and spur gears insure easy and noiseless operation. Seamless brass pockets. Complete with one set of milk test bottles, one 17.6 cc. pipette, one acid measure, one brush for cleaning test bottles, and full directions.

Cat. No.	2440B	2441B
Capacity, bottles	8	12
Each	**$22.00**	**24.00**

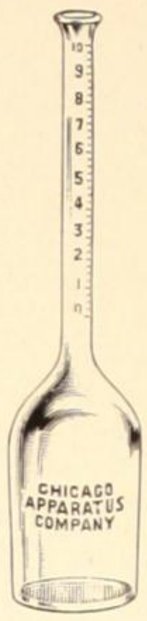
171B. Balance, Babcock Test. Agate Bearing, 5000 Grams x 1/10 Gram. Combines three scales in one—Babcock Test Scale, Double Beam Trip Scale, Solution and Dispensing Scale. Same as our No. 166B Milvay Double Beam Trip Scale with two beams in front, permitting weighings up to 250 grams without extra weights. In the back is a tare beam for counterpoising empty milk and cream test bottles, or other containers weighing less than 50 grams. This scale eliminates the use of 9 and 18 gram weights employed with other Babcock Test Scales—weights which on account of their small size easily get lost **$15.00**



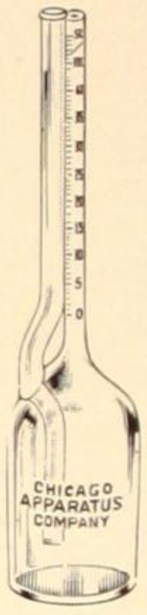
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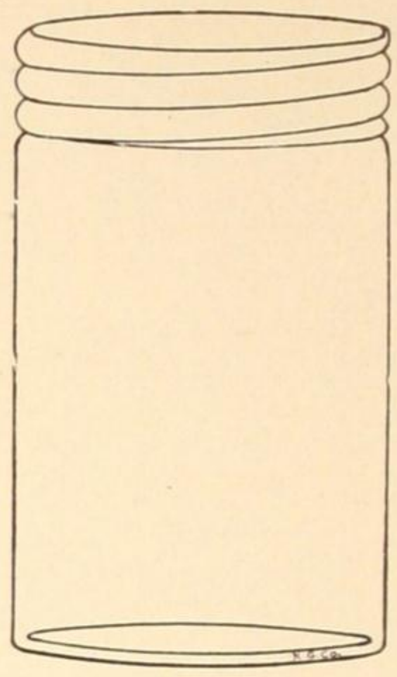
No. 2510B.



No. 2520B.



No. 2525B.



No. 235C.



No. 2560B.



No. 2570B.

2450B. **Acid Dipper, Nafis' Style.** Cap., 8.8 cc. . . **$0.50**

2451B. **Acid Dipper, Nafis' Style.** Cap., 17.5 cc. . **.50**

2460B. **Acid Measure.** Jar type with lip. Capacity, 8.8 cc. **$0.20**

2461B. **Acid Measure.** Jar type with lip. Capacity, 17.5 cc. . . . . **.20**

2470B. **Alkaline Tablet, Farrington's.** For use in determining the degree of acidity of milk, cream or whey. Per box of 100 tablets **$0.60**

2490B. **Balance, Decimal Milk, 30x1/20 lbs.** (Spring Balance Type.) Useful in connection with keeping records of the quantities of milk from individual cows. Provided with tare pointer for offsetting the weight of the pail, making it possible to read the weight of the milk direct without deductions. Indications are in pounds and decimals, a distinct advantage over scales reading in pounds and ounces. Capacity, 30 pounds, in 1/20-pound divisions **$9.00**

Bottles, Milk and Cream Test, Usual Type

2500B. **Bottle, Cream Test.** Glass, 6-inch, 18-gram, 30% by ½% **$0.35**

2505B. **Bottle, Cream Test.** Glass, 6-inch, 18-gram, 40% by 1% **$0.40**

2510B. **Bottle, Cream Test.** Glass, 6-inch, 18-gram, 50% by 1% **$0.35**

2515B. **Bottle, Milk Test.** Glass, 6-inch, 18-gram, 8% by 1/10% **$0.30**

2520B. **Bottle, Milk Test.** Glass, 6-inch, 18-gram, 10% by 1/5% **$0.30**

2525B. **Bottle, Skim Milk Test.** Glass, 6-inch, graduated to 1/100% **$0.85**

Bottles, Milk and Cream Test, Standard Type

The following bottles are made in accordance with the specifications of the Bureau of Standards, Washington, D.C.:

2540B. **Bottle, Cream Test.** Glass, 6-inch, 9-gram, 50% by ½% **$0.40**

2545B. **Bottle, Cream Test.** Glass, 9-inch, 9-gram, 50% by ½% **$0.45**

2550B. **Bottle, Milk Test.** Glass, 6-inch, 18-gram, 8% by 1/10% **$0.40**

235C. **Bottles, Cream Sample.** Aluminum screw cap, round, 1-ounce capacity, for holding cream samples . . . . . **Per dozen $1.10**

140C. **Bottles, Milk Sample.** Round, wide mouth, glass stoppered, for keeping samples for composite tests.

Capacity, ounces	8	16
Per dozen	**$3.75**	**5.00**

2560B. **Brush, Cream Test Bottle.** Bristle end, tinned wire. Length of bristle part, 4¼ inches; diameter at large end, 1½ inches; at small end, ½ inch. Total length, 9½ inches.

Each **$0.12**
Per dozen **1.20**

2570B. **Brush, Milk Test Bottle.** Bristle end, tinned wire. The bristle parts are 2¼ inches long by 1½ inches in diameter and 2⅜ inches long by ½ inch in diameter. Total length, 11 inches.

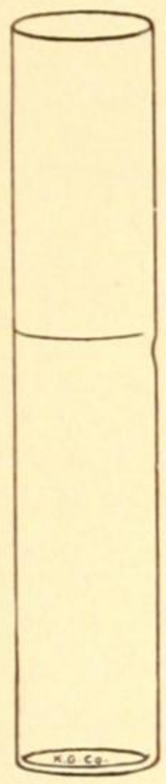
Each **$0.12**
Per dozen **1.20**



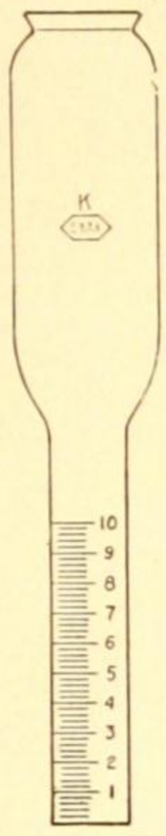
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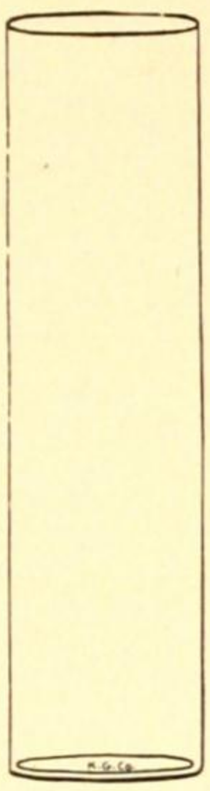
No. 2690B.



No. 2580B.



No. 2590B.



No. 2630B.



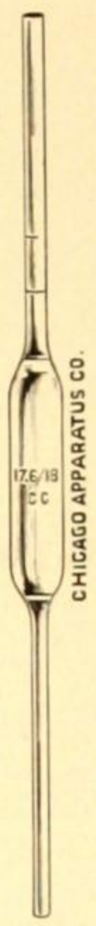
No. 2650B.



No. 2660B.



No. 2670B.



No. 2720B.

2580B. Butter Fat Oil Tube. Test tube shape, flat bottom, with line around tube 5 inches from bottom ..... **Per dozen $1.00**

2590B. Casein Tube, Hart's. Glass. For estimating the amount of casein in milk. Can be used in any Babcock tester **$0.60**

2600B. Charts, Milk Record. For keeping a complete record—in pounds and tenths—of the morning and afternoon production of 10 cows for one week.
Per hundred **$2.25**

2610B. Churn, Dazey. For practical and experimental use. Extra heavy clear glass jars with nickel-plated screw-top, white maple dasher, rust-proof dash rod, noiseless gears. Complete with directions.
Total capacity, pints 6
Churning capacity, pints 4
Each **$3.00**

2620B. Corrosive Sublimate Tablets. For keeping milk samples sweet, used in making composite tests; will keep milk sweet for four weeks. Per box of 100 tablets **$1.00**

2630B. Cream Tubes. For cream samples, test tube shape, flat bottom, 5x1¼ inches..... **Per dozen $0.75**

2640B. Dishes, Milk, Aluminum. Straight sides, flat bottoms.

Diameter, mm.	50	65	75	100
Depth, mm.	12	15	20	25
Each	**$0.20**	.25	.30	.35

2650B. Gray's Moisture Test. For determination of water in butter. Outfit consists of extraction tube, flask, jacket, spirit lamp, 2 rubber corks and 6 cc. cylinder. Complete with directions..... **$5.00**

2660B. Lactometer (Milk Hydrometer). Graduated from 0 to 120 in 2-degree divisions. Length about 11 inches **$0.85**

2670B. Lactometer (Milk Hydrometer). With enclosed thermometer, graduated from 14 to 42 degrees (1.014 to 1.042 specific gravity) in 1-degree divisions. Length about 13 inches..... **$3.50**

2680B. Mann's Acid Test. For determining the extent of the development of lactic fermentation in the ripening of cream, also in cheese making. Outfit consists of burette stand and clamp, 50 cc. burette with pinchcock, 50 cc. pipette, 4 oz. beaker, stirring rod and long-stem funnel. Complete..... **$6.50**

2690B. Milk Sediment Tester. A simple device for testing milk and for cleanliness as indicated by the amount of visible impurities strained or filtered out of a certain quantity, usually one pint. The device is placed over a full pint sample to be tested. The full bottle is next inverted over an empty bottle; by squeezing the bulb, pressure causes the milk to pass rapidly through the cotton disc which retains all gross dirt. Only 10 to 15 seconds required to make test. With 6 dozen cotton discs, but without bottles **$6.75**

2700B. Pipette, Milk. Glass, 8.8 cc..... **$0.35**

2705B. Pipette, Milk. Glass, 17.6 cc. ..... **.35**

2710B. Pipette, Cream. Glass, 9 cc. ..... **.35**

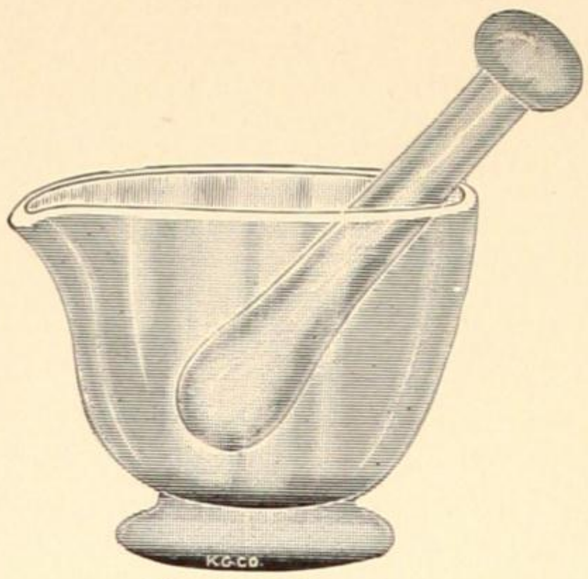
2715B. Pipette, Cream. Glass, 18 cc..... **.35**

2720B. Pipette, Milk and Cream Combined. Glass, 17.6 cc. and 18 cc..... **$0.35**

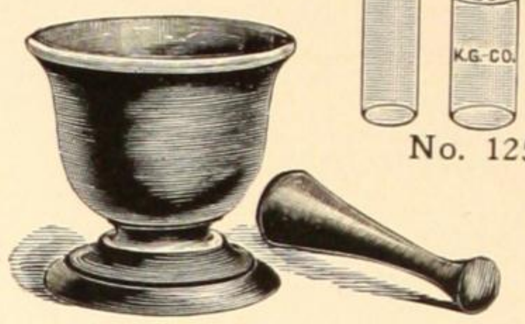
2730B. Rack for Test Bottles. Made of tin and hangs flat against wall, but the bottles stand upright and are easily filled. Holds 36 bottles..... **$5.00**



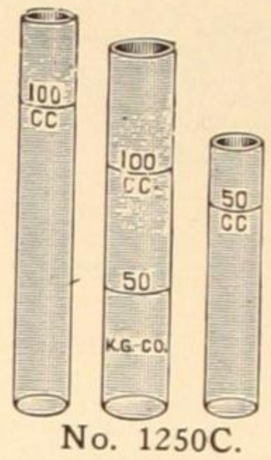
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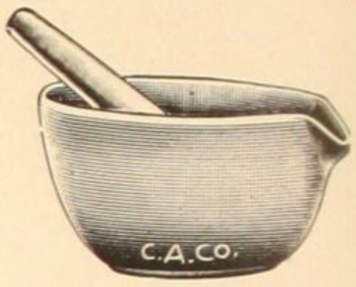
No. 1235C.



No. 1240C.



No. 1250C.



No. 1245C.

1230C. Mortars, Agate. With pestles, of superior quality.

Diam., outside, mm..	50	60	70	100	125
Each	$3.00	3.75	6.00	15.00	25.00

1232C. Mortar, Diamond, Leed's Form. Of hardest tool steel; diameter of pestle, 5/8 inch..... **$3.30**

1235C. Mortars, Glass. Standard form, with lip and pestle.

Capacity, ounces	2	4	8	16
Diameter, inches	3 1/8	4	4 1/8	5 1/2
Each	$0.50	.65	.90	1.50

1240C. Mortars, Iron. Vase shape, with iron pestle.

Capacity, pints	1	2
Each	$1.50	2.50

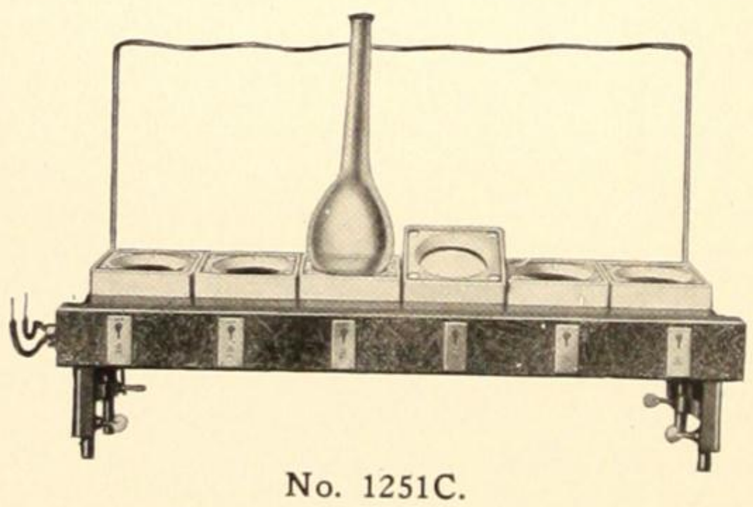
1245C. Mortars, Porcelain. Medium deep form, with lip, rough inside, glazed outside. Pestles all porcelain, glazed except end used for grinding.

Diameter, outside, mm..	65	80	100	130	150	185	213
Each	$0.30	.50	.65	1.00	1.35	1.60	2.00

1250C. Nessler Tubes. For color comparison, usual form, special colorless glass; height of 50 cc. mark on 50 cc. tube, approximately 125 mm.; height of 100 cc. mark on 100 cc. tube, about 190 mm.

Graduated, cc.	50	100	50 and 100
Each	$0.75	.90	1.00

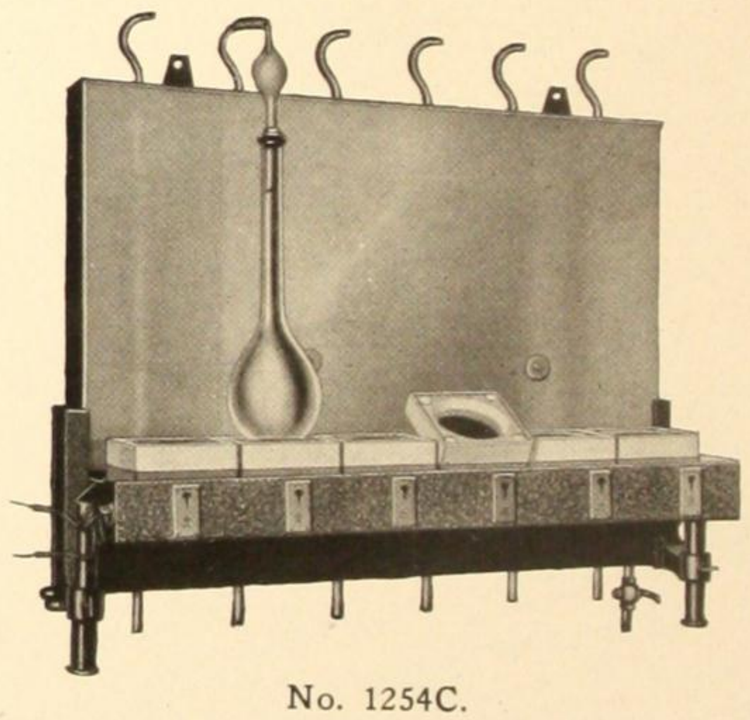
Nitrogen Determination Apparatus



No. 1251C.

1251C. Kjeldahl Digestion Shelf, Electric. With Precision Electric Heaters, fitted with porcelain clay tops with bevelled opening for 500 cc. and 800 cc. Kjeldahl flasks. Each heater draws 550 watts and is set in an angle iron frame, which is adjustable in height for various sizes of flasks. The wiring to the line is according to Underwriters' specifications and is enclosed in a metal box fitted to the front of the apparatus. This box is fitted with separate tumbler switches, so that one or any number of heaters may be used at one time. For operation on 110 volts. Without glassware.

No.	A	B
Number of heaters	6	10
Each	$60.00	95.00



No. 1254C.

1252C. Kjeldahl Digestion Shelf, Gas Heated. Similar to No. 1251C, but equipped with No. 493C Improved Fletcher Burners, adjustable for artificial, natural, or gasoline gas. Fitted with porcelain clays with bevelled opening for 500 cc. and 800 cc. Kjeldahl flasks. A removable shield, for protecting the burner flames, is set inside the frame. The shelf is made of angle iron frame set in heavy cast-iron end supports which are fitted with legs adjustable for height to accommodate various sizes of flasks. Without glassware.

No.	A	B
Number of burners	6	10
Each	$24.00	40.00

Nitrogen Determination Apparatus (Continued)

1253C. Kjeldahl Distilling Apparatus, Electric, Table Type. Improved form, provided with six precision electric heaters with porcelain clay tops with bevelled opening for 500 cc. and 800 cc. Kjeldahl flasks. Each heater draws 550 watts and is provided with separate tumbler switch, so that one or any number of heaters may be used at one time. The condenser is made of copper, tin lined, with six block tin condensing tubes and is well braced and guaranteed not to bulge. The trough is supplied with filling and overflow stopcocks. The large cast-iron legs are readily detached so that the apparatus may be used as a wall type when so desired. Complete as described, but without glassware, for operation on 110 volts **$110.00**

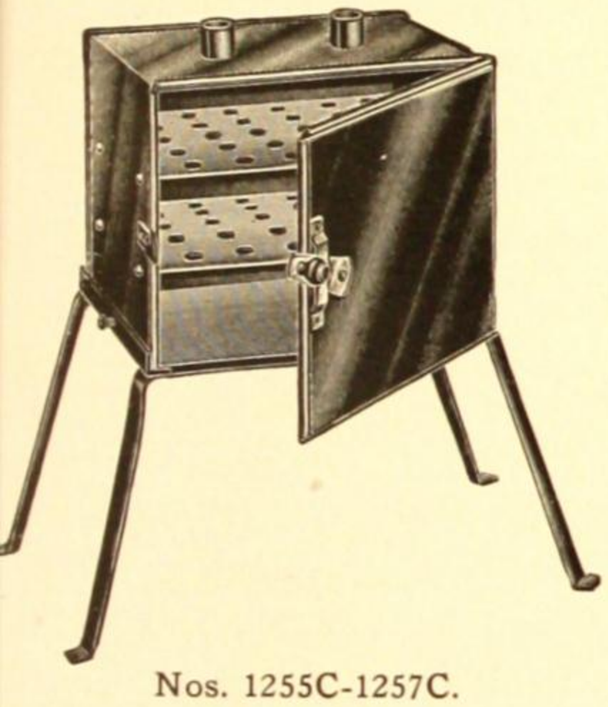
1254C. Kjeldahl Distilling Apparatus, Electric, Wall Type. Same as No. 1253C, but without supporting legs and with means provided for suspending from wall **$100.00**

6040C. Kjeldahl Distilling Apparatus, Gas Heated, Table Type. Similar to No. 1253C, but equipped with six No. 493C Fletcher Burners, adjustable for artificial, natural, or gasoline gas. Fitted with porcelain clays with bevelled opening for 500 cc. and 800 cc. Kjeldahl flasks. A removable shield, for protecting burner flames, is set inside the frame. All flasks, burners, and receivers may be handled from the front without interference. The stand is made of cast-iron and is extra heavy. Supports and the legs are removable so that the apparatus can be changed to the wall type if desired. Without glassware.. **$85.00**

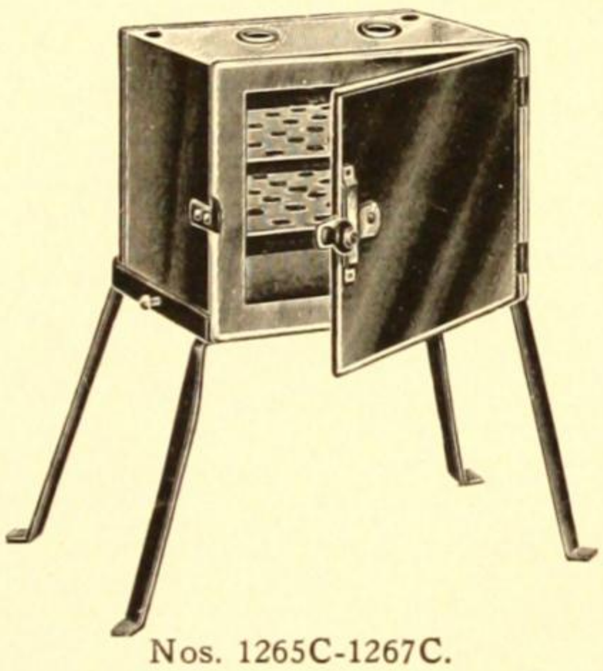
6045C. Kjeldahl Distilling Apparatus, Gas Heated, Wall Type. Same as No. 6040C, but without supporting legs and with means provided for suspending from wall. Without glassware..... **$75.00**

6050C. Kjeldahl's Distilling and Condensing Apparatus. Complete outfit consisting of florence flask, kjeldahl bulb, Liebig condenser, Erlenmeyer flask, tripod, asbestos center wire gauze, support and clamp **$6.00**

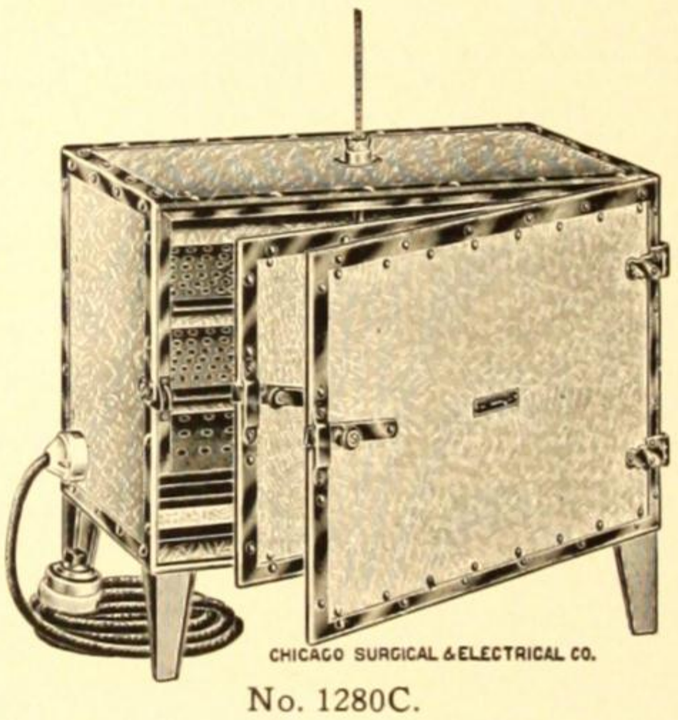
Drying Ovens



Nos. 1255C-1257C.



Nos. 1265C-1267C.



No. 1280C.

1255C. Ovens, Drying, Single Wall. Heavy polished copper, tubulations for thermometer and gas regulator, two removable perforated shelves. On iron support with false bottom.

Cat. No.	1255C	1256C	1257C
Size, inches	6x8x6	8x10x8	10x12x10
Each	**$8.50**	**11.50**	**17.00**

1265C. Ovens, Drying, Double Wall. Same as above, but with double wall forming a water jacket. With two removable perforated shelves and tubulations for thermometer and gas regulator.

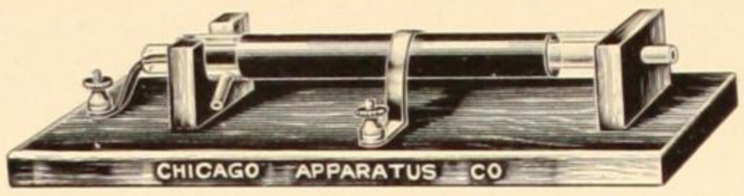
Cat. No.	1265C	1266C	1267C
Size, inches	6x8x6	8x10x8	10x12x10
Each	**$13.00**	**16.50**	**22.00**

1275C. Oven, Drying, Electric. Inside dimensions: Height, 10 inches; width, 14 inches; depth, 10 inches. Single wall construction of insulating material. Two removable shelves. Temperature range 60° to 150° C. Heated electrically and automatically controlled by an Electro-Thermostat. Furnished with pilot lamp. Maximum current consumption, 6 amperes. Without thermometer. For 110-volt A.C. or D.C. **$65.00**

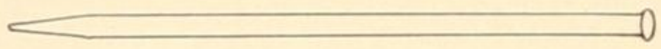
1276C. Oven, Drying, Electric. Same as No. 1275C, but for 220-volt A.C. or D.C..... **$65.00**

1280C. Oven, Drying, Electric. Inside dimensions: Height, 10 inches; width, 18 inches; depth, 10 inches. Double wall construction, outer wall of insulating material, inner wall of Russia iron. Two removable shelves. Temperature range 60° to 200° C. Heated electrically and automatically controlled by an Electro-Thermostat. Furnished with pilot lamp. Maximum current consumption, 12 amperes. Without thermometer. For 110-volt A.C. or D.C.. **$125.00**

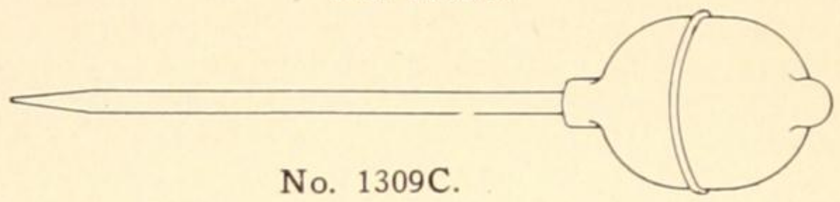
1281C. Oven, Drying, Electric. Same as No. 1280C, but for 220-volt A.C. or D.C..... **$125.00**



No. 1288C.



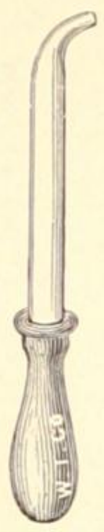
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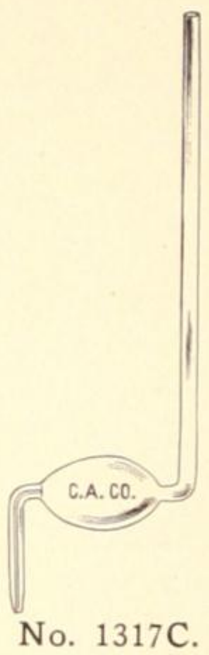
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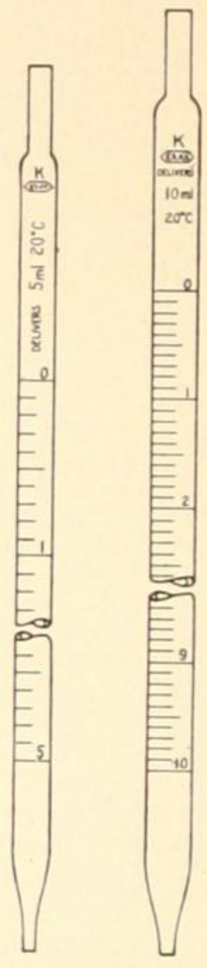
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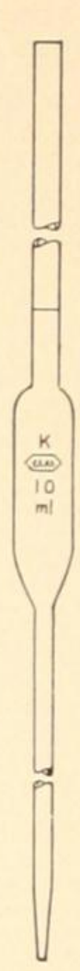
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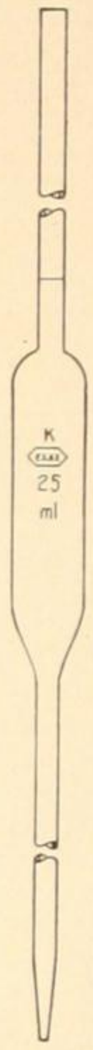
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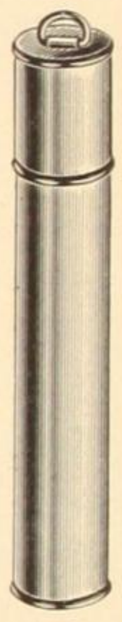
No. 1325C.



No. 1330C.



No. 1332C.



No. 1335C.



1288C. Ozone Apparatus, Siemen's. A simple, efficient lecture-table apparatus for converting oxygen into its allotropic form—ozone. The double-walled glass tube is coated inside and outside with foil. If the outside coating is connected with one pole of an induction coil or static machine, and the inside coating with the other, a silent discharge will pass between the coatings. This electrical discharge passes through the oxygen (contained in the air) flowing through the double-walled tube, converting it into ozone.

On finely finished 40x14 cm. hardwood base, with binding post terminals **$7.50**

1295C. Paper, Glazed, Black. For collecting filter ashes, etc., in sheets 20x24 inches..... **Per quire $0.90**

1296C. Paper, Glazed, White. 20x24 in. **Per quire .65**

1304C. Phosphorus Float. Cork float with wire holder for burning phosphorus..... **$0.35**

1305C. Pencils, Wax. Made like an ordinary lead pencil with colored wax core. For writing on glass, porcelain, etc.

Cat. No.	1305C	1306C	1307C
Color	Blue	Red	Yellow
Each	**$0.20**	**.20**	**.20**

Pipettes

1308C. Pipettes, Dropping. Straight form, without bulb.

Length, inches	8	12
Each	**$0.12**	**.14**

1309C. Pipettes, Dropping. Same as No. 1308C, but with rubber bulb of 25 cc. capacity.

Length, inches	8	12
Each	**$0.32**	**.40**

1310C. Pipettes, Dropping. (Medicine Droppers.) Straight, drawn to a point, fitted with rubber bulb. Length, 4 inches; capacity, 2 cc..... **Per dozen $0.35**

1315C. Pipettes, Dropping. Same as No. 1310C, but with tip curved ..... **Per dozen $0.35**

1317C. Pipette, Mercury. For taking up small drops of mercury without danger of drawing them into mouth, filling barometer tubes, and inserting mercury indices in capillary tubes used in Boyle's law and Charles' law experiments..... **$0.45**

1325C. Pipettes, Mohr's. Accurately graduated in cubic centimeters and fractions.

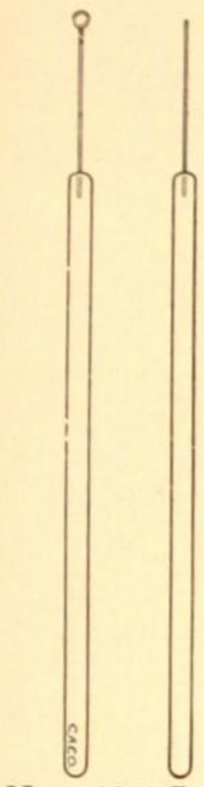
Capacity, cc.	1	2	5	10	25	50
Graduated in, cc.	1/100	1/10	1/10	1/10	1/10	1/10
Each	**$0.36**	**.33**	**.35**	**.40**	**.55**	**.75**

1330C. Pipettes, Volumetric. Glass, with bulb in middle of tube; accurately graduated.

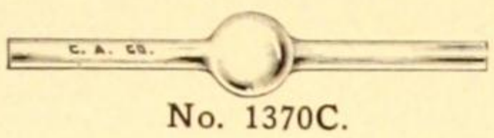
Cap., cc.	1	2	5	10	20	25	50	100
Each	**$0.20**	**.21**	**.22**	**.25**	**.35**	**.40**	**.50**	**.65**

1332C. Pipette Box. Copper, round form, telescoping cover with ring, for holding pipette during sterilization. Length, 15 inches; diameter, 2 inches.... **$2.25**

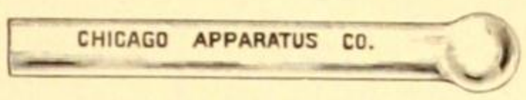
1335C. Pipette Support. Hardwood, revolving, for 12 pipettes **$3.25**



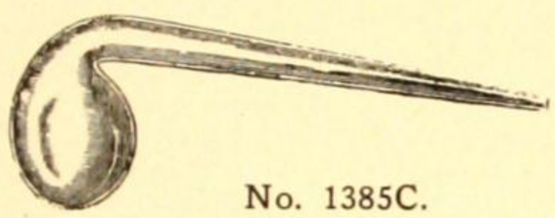
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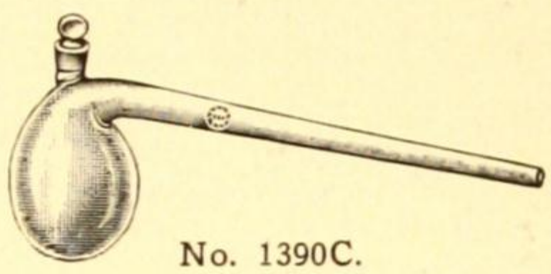
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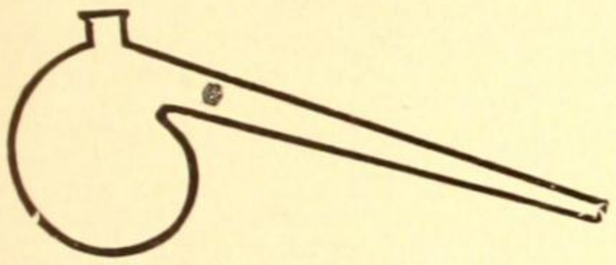


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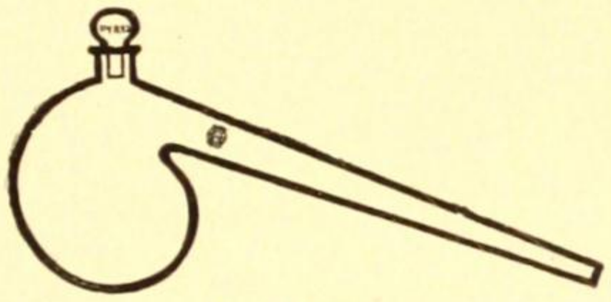


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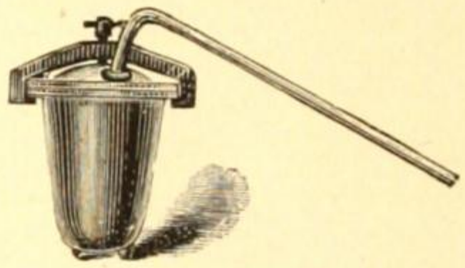
No. 1380C.



No. 1391C.



No. 1392C.



No. 1393C.

Platinum Foil.

Kind	Light	Medium	Heavy
Thickness, inches	.001	.002	.004
Approx. grams per sq. in.	0.353	0.705	1.411

Price—Governed by the market price on platinum.

Platinum Wire.

B&S gauge	18	20	22	24	26	28	30	32	34	36
Gr. per ft.	5.37	3.41	2.08	1.33	.85	.56	.33	.21	.14	.09

Price—Governed by the market price on platinum.

1360C. Platinum Wire. Length, 8 cm.; size No. 30 B. & S. gauge. For flame tests..... **$0.75**

1365C. Platinum Wire. Same as No. 1360C, but with glass handle **$1.00**

1367C. Platinum Loop. Same as No. 1365C, but with end of wire formed into a small loop..... **$1.00**

1370C. Reduction Tube. Hard glass, with bulb in center. Length, 6 inches..... **$0.20**

1375C. Reduction Tube. Hard glass with bulb on end. Length, 6 inches **$0.20**

Retorts

1380C. Retorts, Copper. Flask shape, brass delivery tube with ground joint and iron clamp. For making oxygen.

Capacity, cc.	250	500	1000	2000
Each	**$3.25**	**3.75**	**4.50**	**5.00**

1385C. Retorts, Glass. Plain.

Capacity, cc.	125	250	500
Each	**$0.45**	**.60**	**.70**

1390C. Retorts, Glass Tubulated. Fitted with glass stopper.

Capacity, cc.	125	250	500
Each	**$0.75**	**.90**	**1.30**

1391C. Retorts, Pyrex Glass. With tubulation, without stoppers.

10% discount when ordered in original case.

Capacity, cc.	125	250	500
No. in original case	36	28	18
Each	**$1.60**	**2.00**	**3.00**

1392C. Retorts, Pyrex Glass. With Pyrex stopper.

10% discount when ordered in original case.

Capacity, cc.	125	250	500
No. in original case	36	28	18
Each	**$2.40**	**2.80**	**3.80**

1393C. Retorts, Iron. For distilling mercury, etc. Removable cover held in place by screw clamp, delivery tube ground in cover.

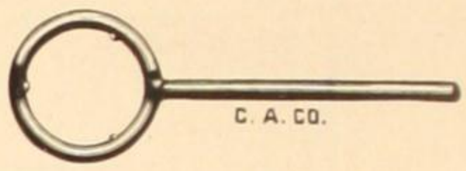
Capacity, cc.	250	500	1000	2000
Each	**$3.50**	**4.50**	**5.50**	**7.00**



No. 1394C.



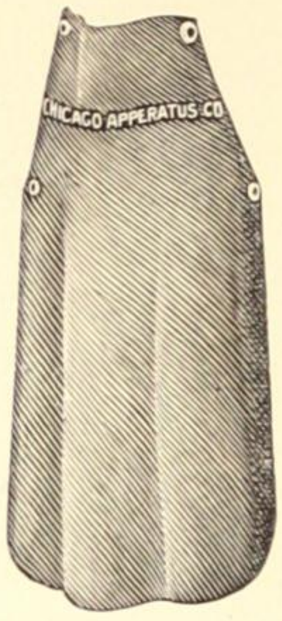
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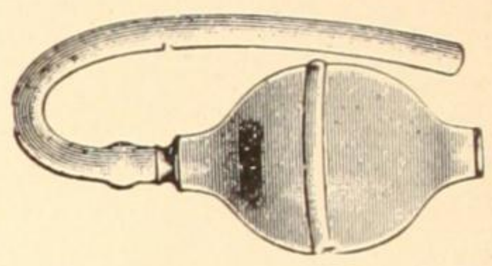
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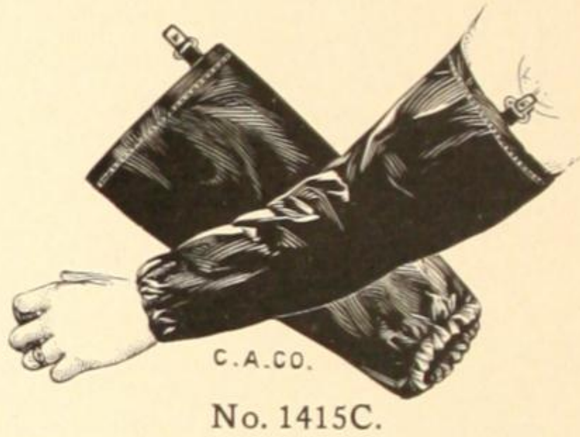
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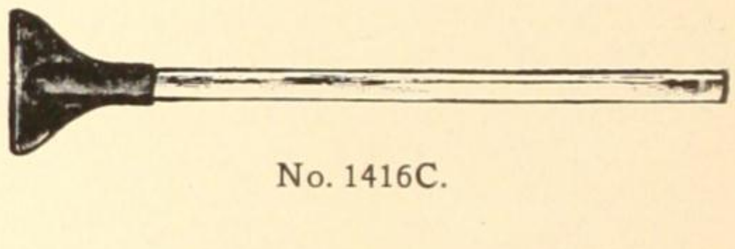
No. 1410C.



No. 1414C.



No. 1415C.



No. 1416C.

1394C. Rings, Support. Japanned cast iron with solid brass screw clamp; for fastening to any support rod up to ½ inch in diameter. Distance from rod to center of rings, 4¼ inches.

Diameter outside, in...	2	3	4	5	6	7
Each	$0.20	.22	.25	.30	.35	.40

1400C. Rings, Support. Same as No. 1394C, but with opening. For funnels, leveling bulbs, etc.

Cat. No.	1400C	1401C
Diameter outside, inches	1¾	3¼
Each	$0.20	.25

1405C. Rings, Support, Extension. Japanned cast iron, distance from end of rod to center of ring, 8½ inches. For fastening to support rod by means of clamp holder like our No. 665C.

Cat. No.	1405C	1406C	1407C
Diameter outside, inches	3	4	5
Each	$0.18	.22	.25

1408C. Laboratory Gown, White Drill. This gown is made of an excellent quality of drill and is superior to the aprons commonly used in that it completely protects the clothing. As a convenience, the gown has three pockets and the buttons can be removed to facilitate laundering. 54 inches long. **In ordering be sure to specify chest measure taken loosely** . . **$4.00**

1409C. Laboratory Gown, Khaki Drill. Same as No. 1408C, but made of brown khaki drill and 50 inches in length. **In ordering, be sure to specify chest measure taken loosely** **$4.00**

Rubber Goods of All Kinds

1410C. Rubber Apron. For laboratory use. Protects wearer against injury to clothes and against danger from acid burns. Made of light-weight pure black rubber cloth. Acid and waterproof, very flexible. Length, 48 inches **$1.00**
10% discount in dozen lots, 20% discount in lots of 25.

***1415C. Rubber Oversleeves.** Made of the same material as No. 1410C Apron, with elastic bands at top and bottom **$0.60**

1414C. Rubber Bulb, with connecting tube. With hard rubber valves, for pressure only. Capacity about 50 cc. **$0.40**

1416C. Rubber Policemen. Wing shaped rubber tip 1⅛ inches wide at end, on 6x$\frac{3}{16}$-inch glass rod. **Per dozen** **$1.20**

1417C. Rubber Policemen. Same as 1416C, but without glass rod..... **Per dozen $0.60**
***10% discount in lots of 12.**

Rubber Stoppers and Tubing



No. 1420C (Two-hole).

1420C. **Rubber Stoppers.** These rubber stoppers will not exceed in specific gravity 1.30. This fact should be remembered in buying rubber stoppers by the pound, since the lower the specific gravity the greater number of stoppers there are to the pound. Oftentimes rubber stoppers of a higher specific gravity are purchased because they are of a lower price, whereas they are really more expensive since a smaller number of stoppers are received. Likewise, if the stopper has a specific gravity very much higher than 1.30 it means that it is heavily loaded with some substance other than pure gum rubber which will effect the aging quality of the stopper. The stoppers listed below do not contain any corn oil nor any other rubber substitute, but are made of pure rubber. They will not harden from age and are made according to a formula which has been found especially adapted for chemical laboratory purposes.

NOTE: In ordering give size, number and specify solid, one-hole, or two-hole as desired.

Size No.	00	0	1	2	3	4	5	5½	6
Diameter, small end, mm.	9	12	15	16	18	20	23	24	26
Diameter, large end, mm.	14	17	18	20	23	25	27	28	32
Solid, per dozen	**$0.18**	**.25**	**.37**	**.40**	**.54**	**.63**	**.76**	**.90**	**1.02**
One-hole, per dozen	**.16**	**.24**	**.35**	**.38**	**.50**	**.60**	**.72**	**.85**	**.96**
Two-hole, per dozen	**.15**	**.22**	**.33**	**.36**	**.48**	**.58**	**.68**	**.80**	**.91**
Any style, per pound	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**
Size No.		6½	7	8	9	10	11	12	13
Diameter, small end, mm.		27	30	33	37	42	48	53	61
Diameter, large end, mm.		34	37	41	45	50	56	63	68
Solid, per dozen		**$1.20**	**1.35**	**1.72**	**1.90**	**2.60**	**3.20**	**4.40**	**5.40**
One-hole, per dozen		**1.15**	**1.32**	**1.65**	**1.80**	**2.50**	**3.00**	**4.20**	**5.30**
Two-hole, per dozen		**1.05**	**1.27**	**1.60**	**1.76**	**2.42**	**2.90**	**4.10**	**5.12**
Any style, per pound		**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**

1421C. **Rubber Stoppers, Three-Hole, No. 6.** Diameter of small end 26 mm., diameter of large end 32 mm.
Per dozen ..... **$0.90** **Per lb.** **$1.50**

1422C. **Rubber Stoppers, Three-Hole, No. 7.** Diameter of small end 30 mm., diameter of large end 37 mm.
Per dozen ..... **$1.25** **Per lb.** **$1.50**

1423C. **Rubber Stoppers, Assorted.** One-pound bag of solid, one-hole and two-hole, from Nos. 2 to 6—sizes most useful in the chemical laboratory **$1.50**

1424C. **Rubber Stoppers, Assorted.** Same as No. 1423C, but two-pound bag, from Nos. 00 to 8 ..... **3.00**

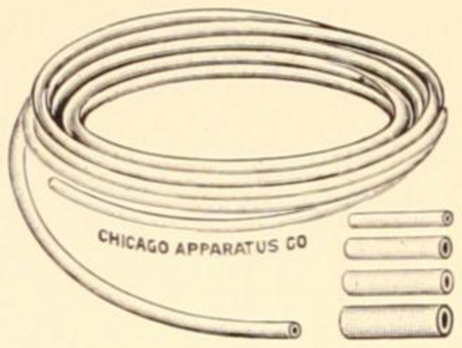
1425C. **Rubber Tubing, Black, Medium Wall, Milvay Quality.** Hand-made, seamless, soft pure gum, floating stock, sp. gr. under 1.00. Sold only in 3′—6′—9′ and 12′ lengths.

Diameter inside, inches	1/8	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	1/32	1/32	1/16	1/16	1/16	3/32
Per foot	**$0.08**	**.09**	**.12**	**.15**	**.20**	**.36**

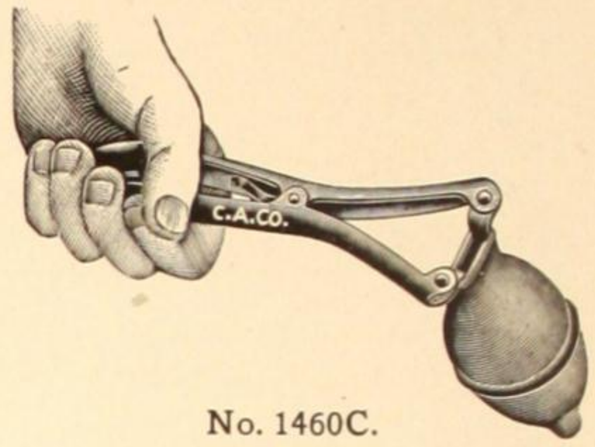
1430C. **Rubber Tubing, Black, Heavy Wall, Milvay Quality.** Hand-made, seamless, soft pure gum, floating stock, sp. gr. under 1.00. Sold only in 3′—6′—9′ and 12′ lengths.

Diameter inside, inches	5/32	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	1/16	1/16	3/32	3/32	3/32	1/8
Per foot	**$0.18**	**.20**	**.21**	**.25**	**.35**	**.45**

Rubber Tubing (Continued)



Nos. 1425C-1455C.



No. 1460C.

1435C. Rubber Tubing, Pressure, Heavy Wall, Milvay Quality. 1 braid-woven cloth inserted 1/8-inch wall. This tubing is not recommended for vacuum work but will withstand fairly high pressure such as when used in connection with compression pumps, etc. Sold only in 3'—6'—9' and 12' lengths.

Diameter inside, inches	3/16	1/4	5/16	3/8
Per foot	**$0.15**	**.17**	**.20**	**.25**

4425R. High Vacuum Rubber Tubing. A special extra heavy wall, pure gum tubing for air pump connections, filter connections, mercury leveling bulbs, and high vacuum work. It is air-tight, gas-tight, and "clings" to inlets, outlets, and glass tubing. Its specific gravity is under 1.00 and because of the formula and method of curing employed will give years of service. Sold only in 3'—6'—9' and 12' lengths.

No.	A	B	C
Bore, inches	1/8	3/16	1/4
Wall, thickness, inches	3/32	3/16	3/16
Per foot	**$0.20**	**.30**	**.35**

1440C. Rubber Tubing, Red Antimony, Medium Wall, Milvay Quality. Hand-made, cured in cloth, cloth impression. This is an antimony cured tubing which we recommend highly for general laboratory purposes having a sp. gr. of 1.3. Sold only in 3'—6'—9' and 12' lengths.

Diameter inside, inches	1/8	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	1/32	1/32	1/16	1/16	1/16	3/32
Per foot	**$0.10**	**.12**	**.13**	**.15**	**.20**	**.36**

1445C. Rubber Tubing, Red Antimony, Heavy Wall, Milvay Quality. Similar to 1440C, but with a heavy wall. Sold only in 3'—6'—9' and 12' lengths.

Diameter inside, inches	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	1/16	3/32	3/32	3/32	1/8
Per foot	**$0.19**	**.22**	**.25**	**.28**	**.47**

1450C. Rubber Tubing, White, Light Wall. Cloth impression. Best quality seamless zinc oxide cured tubing. Sp. gr. of 1.25. Excellent for general laboratory purposes. Sold only in 3'—6'—9' and 12' lengths.

Diameter inside, inches	1/8	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	3/64	3/64	1/16	1/16	1/16	1/16
Per foot	**$0.08**	**.10**	**.11**	**.14**	**.15**	**.23**

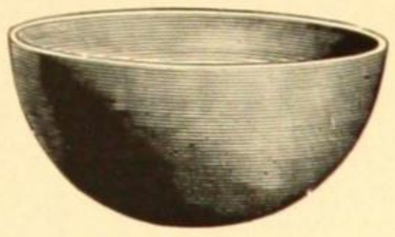
1452C. Rubber Tubing, White, Medium Wall. Same quality as 1450C, but with a slightly heavier wall. Made especially for Bunsen Burner use.

Diameter inside, inches	3/16	1/4
Thickness of wall, inches	1/16	3/32
Per foot	**$0.16**	**.18**

1455C. Rubber Tubing, White, Heavy Wall. Cloth impression. Best quality seamless zinc oxide cured tubing. Sp. gr. of 1.25. Excellent for general laboratory purposes. Sold only in 3'—6'—9' and 12' lengths.

Diameter inside, inches	3/16	1/4	5/16	3/8	1/2
Thickness of wall, inches	3/32	1/8	1/8	1/8	1/8
Per foot	**$0.21**	**.24**	**.30**	**.32**	**.37**

1460C. Rubber Tubing Expander. (Bulb expander.) For increasing bore of tubing for conveniently slipping over connection tubes, etc. **$0.65**



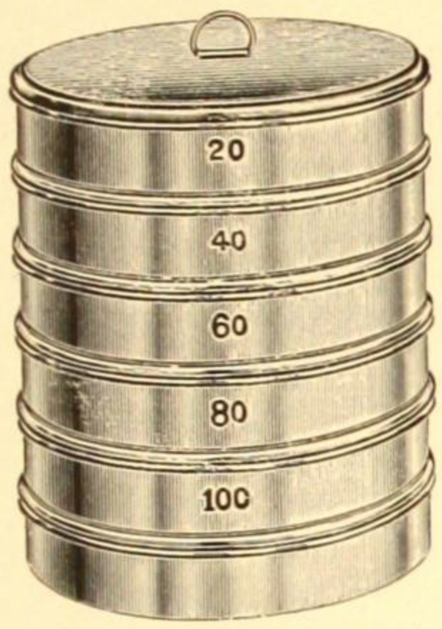
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No. 1465C.



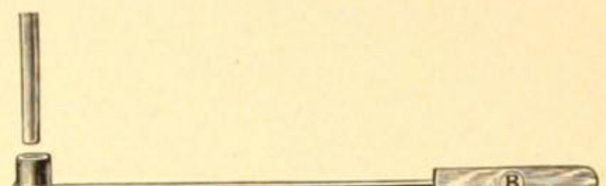
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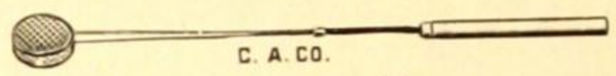
No. 1480C.



Nos. 1485C-1490C-1495C.



No. 1505C.



No. 1510C.

1462C. Sand Baths. Deep form of sheet iron.

Diameter, inches	4	6	8	10
Each	$0.12	.30	.55	.90

1465C. Sand Baths. Shallow form of sheet iron.

Diameter, inches	3	4	5	6	8	10
Each	$0.10	.12	.14	.20	.40	.75

555W. Sand Paper. No. 1 abrasive, in sheets about 9x11 inches.
Per sheet $0.06

1476C. Scoops, Agateware. 3x5½ inches, with handle ..... .35

1477C. Scoops, Horn. Flat and wide, square ends.

Length, cm.	10	12	16
Each	$0.25	.30	.45

1480C. Sieves, Brass Frame. Set of five. Very useful in separating soils, chemicals and other substances into different grades of fineness. Seamless brass frames, brass gauze bottoms, one sieve fits snugly on top of another, with one cover and one pan bottom. Diameter, 5 inches. Set includes one each 20, 40, 60, 80 and 100 mesh $13.00

1485C. Sieves, Brass Frame. Same as in set No. 1480C. Diameter, 5 in.

Cat. No.	1485C	1486C	1487C	1488C	1489C
Mesh	20	40	60	80	100
Each	$2.00	2.20	2.40	2.50	2.70

1490C. Bottom Pan. For No. 1485C sieves $0.90

1495C. Cover. For No. 1485C sieves 1.10

1500C. Sieves, Wood Frame. Set of five. Brass gauze bottoms; diameter, 6 inches; one each 20, 40, 60, 80 and 100 mesh $4.00

1505C. Sodium Capsule. According to Brownlee. Brass capsule on end of metal holder with wood handle; total length, 20 cm.; brass ram rod, 12.5 cm. x 6 mm. $0.35

1510C. Sodium Spoon. New form, with two copper gauze bowls, 3 cm. diameter, on the ends of slender metal rods mounted on wood handle. Bowls are opened and closed by means of a metal slider. Total length, 33 cm. $0.60



No. 1515C.



No. 1520C.



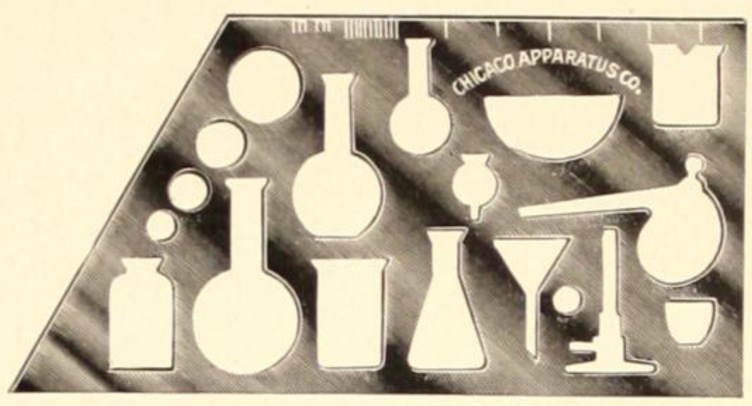
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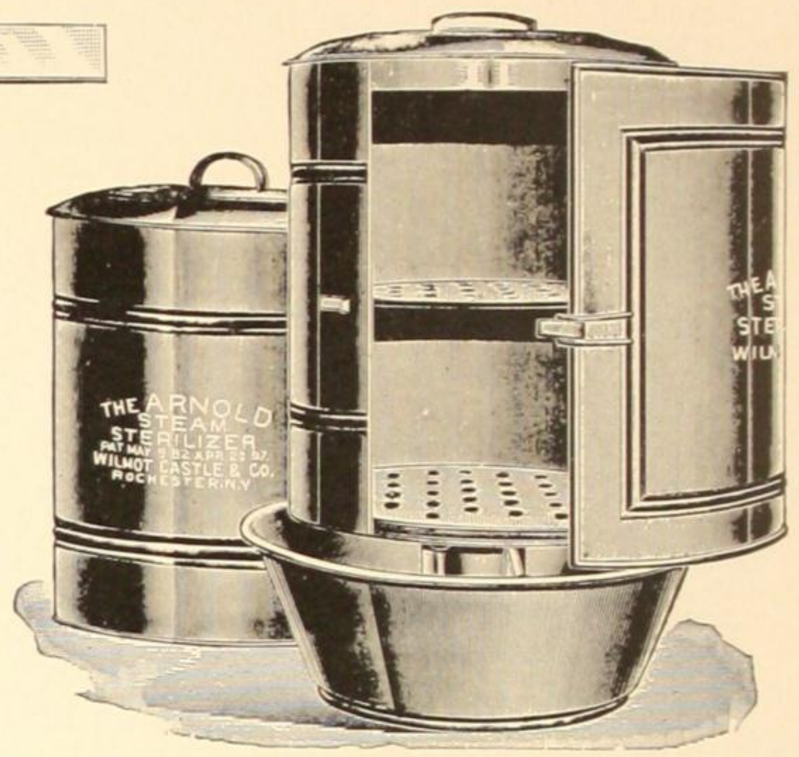
No. 1540C.



No. 1545C.



No. 1550C.



Nos. 3513B-3514B.

1515C. Spatulas, Horn. Double, with spatula on each end.

Length, inches	4	6
Each	$0.20	.30

1520C. Spatulas, Porcelain. Double, with spatula on each end.

Length, mm.	120	150	195
Each	$0.30	.40	.50

1525C. Spatulas, Steel. Flexible blade, cocoa wood handle.

Length of blade, inches	3	4	5	6
Each	$0.35	.40	.45	.60

1530C. Splints. Thin flat wood strips about 3/8x4¾ inches, in full standard packages of about 500.
Per package $0.20

1535C. Sponges, very soft. Selected quality, for cleaning glassware, porcelainware, etc.... **Each $0.20**

1536C. Sponges. Same as No. 1535C but in pound packages. There are 16 sponges to the pound.
Per pound $1.50

1537C. Spoon, Aluminum. Length, 10 inches; bowl, 3⅜x2 inches $0.20

1540C. Spoons, Horn. With spatula end.

Length, inches	4	6
Each	$0.15	.25

1542C. Spoon, Iron, Table. Tinned Iron Table Spoon $0.10

1545C. Spoons, Porcelain. Spoon on one end, spatula on the other.

Length, mm.	120	145	195
Each	$0.30	.40	.60

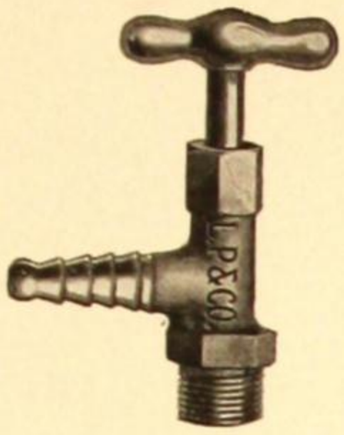
***1550C. Stencil, Chemistry.** A flexible transparent plate with "cut-outs" representing outlines of various chemical utensils. The ruling edges of the obtuse angle serve as convenient guides in drawing delivery tubes. One edge has a metric scale for dimensions. Recommended by prominent teachers of chemistry because its use eliminates bad drawings, saves time, inspires the pupil, holds his attention and induces accurate thinking. Size, about 7.5x14.5 cm..... $0.15
***20% discount in lots of 100.**

3513B. Sterilizers, Arnold Steam, Cylindrical Form. For sterilization at steam temperature—100 degrees C.—212 degrees F. Improved type with two movable perforated shelves, quick-steaming base, and removable hood. Requires no special burner for heating. A very thin layer of water, kept at constant level by a large reservoir, causes almost instant formation of steam, and as a result the action of this sterilizer is very rapid. The steam after escaping from the sterilizing chamber condenses and returns to the water reservoir to be used over again. Made of heavy tin with copper bottom. Complete, but without burner.

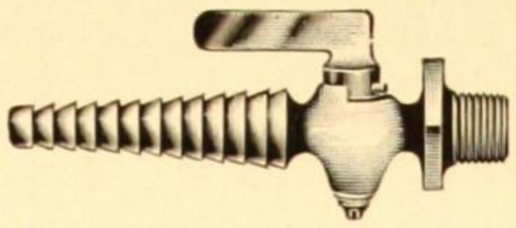
No.	A	B	C
Height, inside, inches	7⅛	11¾	12½
Diameter, inside, inches	8½	10⅛	10⅞
Each	$11.50	14.00	16.00

3514B. Sterilizers, Arnold Steam, Cylindrical Form. Same as No. 3513B, but made entirely of heavy polished copper. Complete, but without burner.

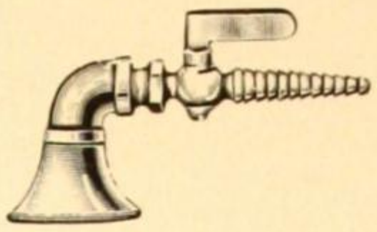
No.	A	B
Height, inside, inches	11¾	12½
Diameter, inside, inches	10⅛	10⅞
Each	$35.00	37.00



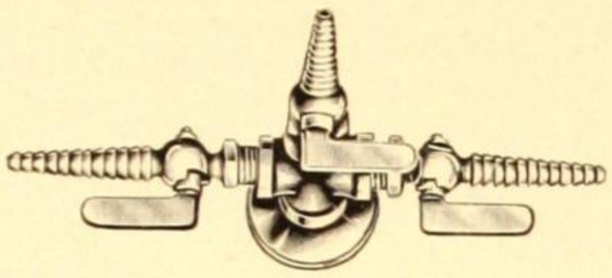
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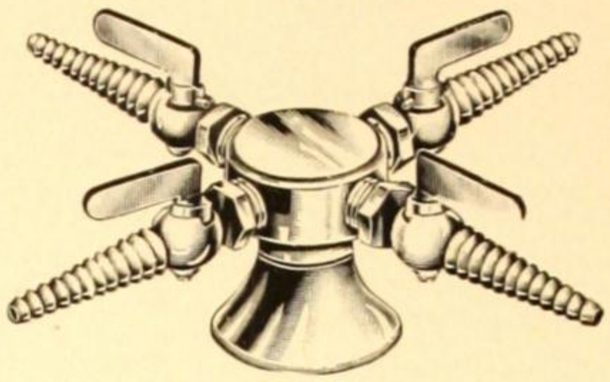
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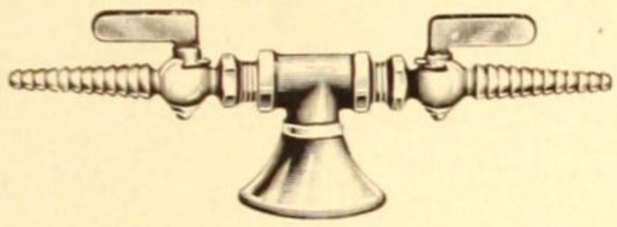
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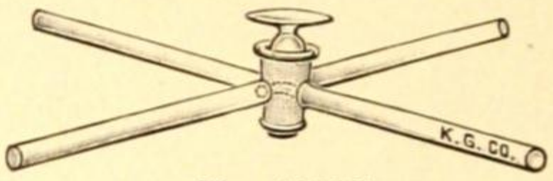
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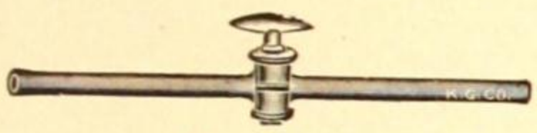
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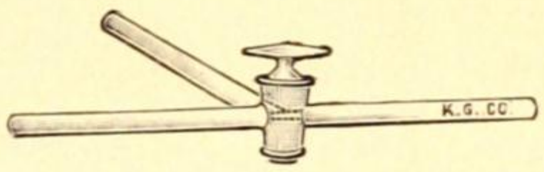
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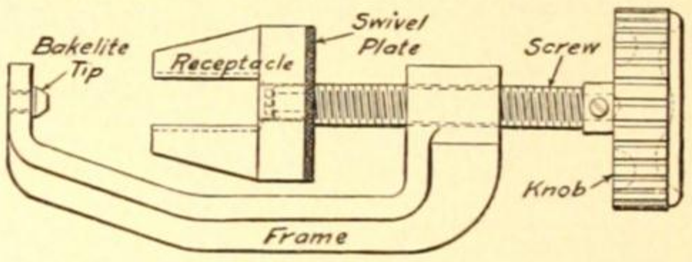
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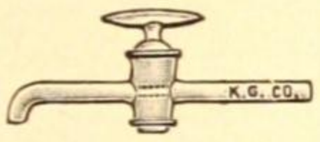
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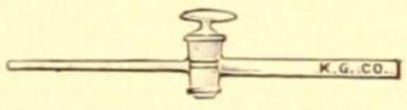
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No. 1595C.



No. 1585C.



No. 1590C.

1551C. Stopcock, Brass, for Gas. Improved form, with needle point regulator. The hose connection is serrated and will take various sizes of rubber tubing. Threaded to fit couplings for ⅜-inch inside diameter gas pipe. Made of brass, nickel-plated **$1.50**

1552C. Stopcock, Laboratory, for Gas. Made of brass, nickel-plated, with ⅜-inch standard I.P. male thread. Has serrated and tapered hose connection for ¼ to ½-inch bore rubber tubing. The large number (12) and sharp serrations prevent tubing slipping off accidentally **$1.30**

1554C. Stopcock, Laboratory, for Gas. Same as No. 1552C, but with addition of elbow and flange.. **$2.60**

1556C. Stopcock, Laboratory, for Gas. Two-way, with two No. 1552C stopcocks and flange..... **$4.00**

1557C. Stopcock, Laboratory, for Gas. Three-way, with three No. 1552C stopcocks and flange.... **$6.50**

1558C. Stopcock, Laboratory, for Gas. Four-way, with four No. 1552C stopcocks and flange.... **$8.95**

IRON PIPE (I.P.) THREAD RATINGS. *Threads cut on the outside of an iron pipe having an inside diameter or bore of ⅛ inch are designated as ⅛ inch I. P. threads. The actual diameter of such threads is the outside diameter of the iron pipe, which for ⅛-inch bore I.P. is ⅜-inch, ¼-inch I.P. 7/16 inch, ⅜-inch I.P. ⅞ inch, and ¾-inch I.P. 1 3/16 inches. Because filter pumps, couplings, and gas stopcocks are used on water and gas pipes they are rated in I.P. thread sizes.*

1570C. Stopcock, Glass. Straight.

Bore, mm.	2	3	4	5
Each	**$1.00**	**1.05**	**1.10**	**1.35**

1575C. Stopcock, Glass. Three-way.

Bore, mm.	2	3	4
Each	**$1.45**	**2.00**	**2.50**

1580C. Stopcock, Glass. Four-way.

Bore, mm.	2	3	4
Each	**$1.60**	**2.25**	**2.75**

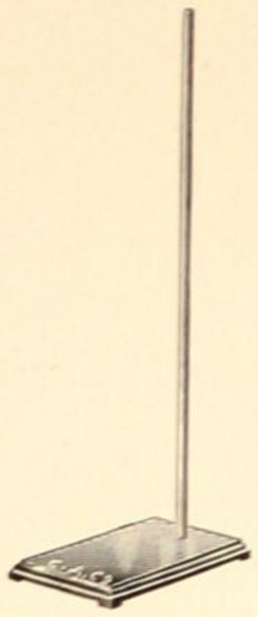
1585C. Stopcock, Glass. Bent.

Bore, mm.	1	2	3	4	5
Each	**$1.00**	**1.20**	**1.35**	**1.45**	**1.50**

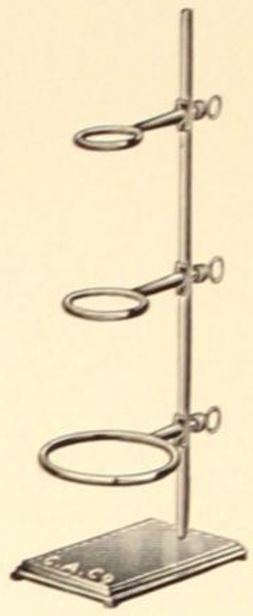
1590C. Stopcock, Glass. Straight, light weight for attaching to burettes. Inlet tube 4-mm. bore and outlet tube 2-mm. bore **$1.10**

165W. Stopcock Grease, Ernest's. Does not dry out or harden, makes stopcocks leak-proof and prevents plugs from sticking. Resistant to reagents; a perfect lubricant for brass and glass stopcocks.
Per tube **$0.35**

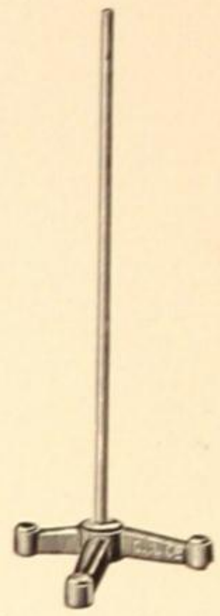
1595C. Stopcock Remover. For removing stopcock plugs that have become stuck. In use the bakelite tip bears against the bottom of the plug, the jaws of the receptacle against the upper edge of the body of the stopcock, while the slot in the receptacle engages the handle of the plug. Turning the knob applies both pressure and twist to the plug, and it is this combined action that makes this device so effective even when plugs are badly "frozen." The frame is of manganese-bronze, the screw of phosphor-bronze; the knob of vulcanite; and the receptacles, four in number for various size stopcocks, of wood. Complete **$5.00**



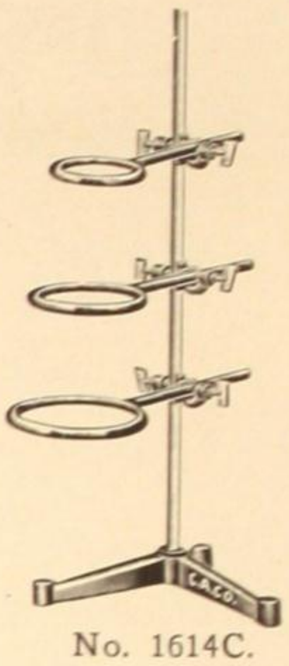
Nos. 1600C-1603C.



No. 1606C.



Nos. 1610C-1613C.



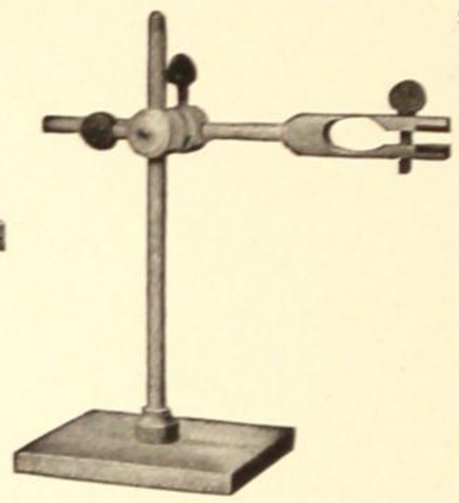
No. 1614C.



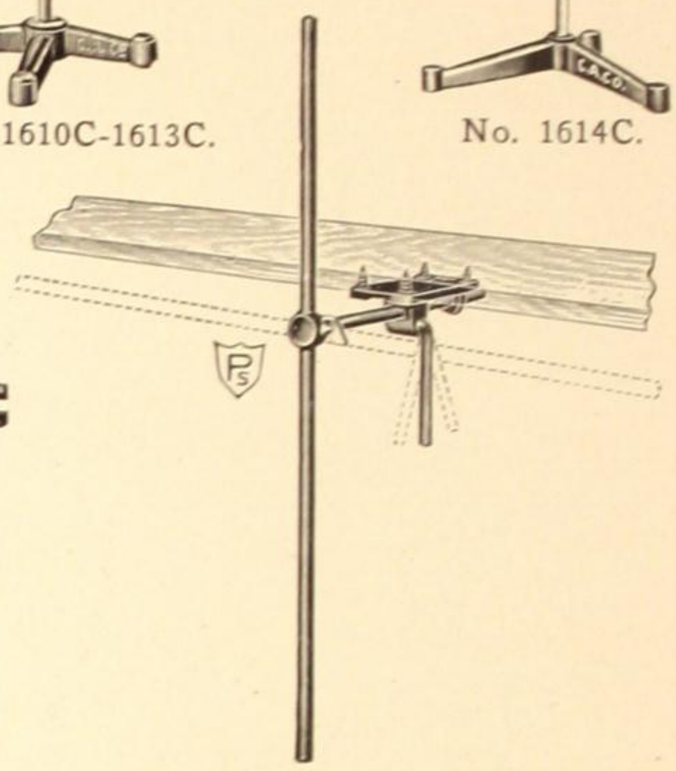
No. 1615C.



No. 1617C.



No. 1620C.



No. 1622C.

Supports for Burettes are listed on page 405.
Supports for Funnels are listed on page 436.
Supports for Pipettes are listed on page 452.
Supports for Test Tubes are listed on page 462.

*1600C. **Supports, Iron.** Rectangular base, with coppered steel rod.

Cat. No.	1600C	1601C	1602C	1603C
Size of base, ins.	4x6½	5x8	5½x8½	6½x9⅜
Length of rod, ins.	18	20	24	36
Each	**$0.40**	**.60**	**.85**	**1.40**

*1605C. **Supports, Iron.** Rectangular base, coppered steel rod, with No. 1394C rings.

Cat. No.	1605C	1606C	1607C	1608C
Size of base, ins.	4x6½	5x8	5½x8½	6½x9⅜
Size of rod, ins.	5/16-18	⅜-20	½-24	½-36
Outside diameter of rings, ins.	3, 4	3, 4, 5	3, 4, 5, 6	3, 4, 5, 7
Each	**$0.95**	**1.40**	**1.70**	**2.50**

*1610C. **Supports, Iron.** Tripod base, with coppered steel rod.

Cat. No.	1610C	1611C	1612C	1613C
Size of rod, ins.	5/16-18	⅜-20	½-24	½-36
Length of leg, ins.	3¼	4⅛	5⅛	7
Each	**$0.55**	**.70**	**1.25**	**1.50**

*1614C. **Support, Iron.** Tripod base, 20-inch coppered steel rod, one each extension rings 3, 4 and 5 inches diameter, and 3 clamp holders.....**$2.25**

1615C. **Support, Universal.** Schellbach's. Hardwood, oil finish **$2.25**

1617C. **Support, Hardwood, Gay-Lussac's.** With cork-lined clamp adjustable in three directions. Length of vertical rod, 16 inches.....**$1.75**

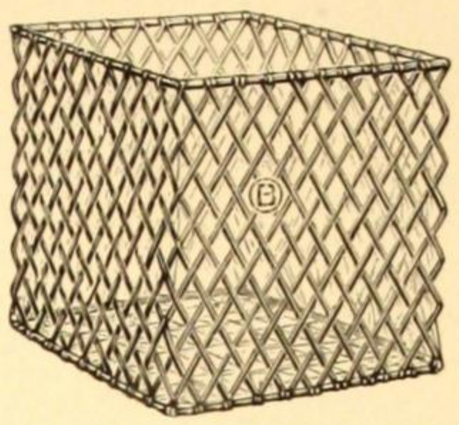
1620C. **Support, Universal.** Hardwood, oil finish, cork-lined clamp with 22-inch rod, ½ inch in diameter **$2.00**

1621C. **Wooden Clamp** only of No. 1620C. For use with iron supports. May be attached to support rod by means of a clamp holder or held in the jaws of a burette or condenser clamp. Length of rod, 10 inches **$1.35**

1622C. **Support, Universal, Farmer.** Consists of a metal bracket which fastens to the underside of a bottle rack with four screws. The bracket rod, 10 inches long, is free to turn or slide in the bracket except when locked by the eccentric lever. The apparatus rod is 20 inches long, heavily nickel-plated and held in a socket provided with screw for locking it into any desired position. This support provides quick, easy, and convenient adjustment.....**$1.50**

*20% discount in lots of 50.

1625C. Test Tube Basket. Tinned wire, for sterilizing test tubes, etc.; square shape, 5½ inches long, 5 inches high, 4 inches wide **$1.00**

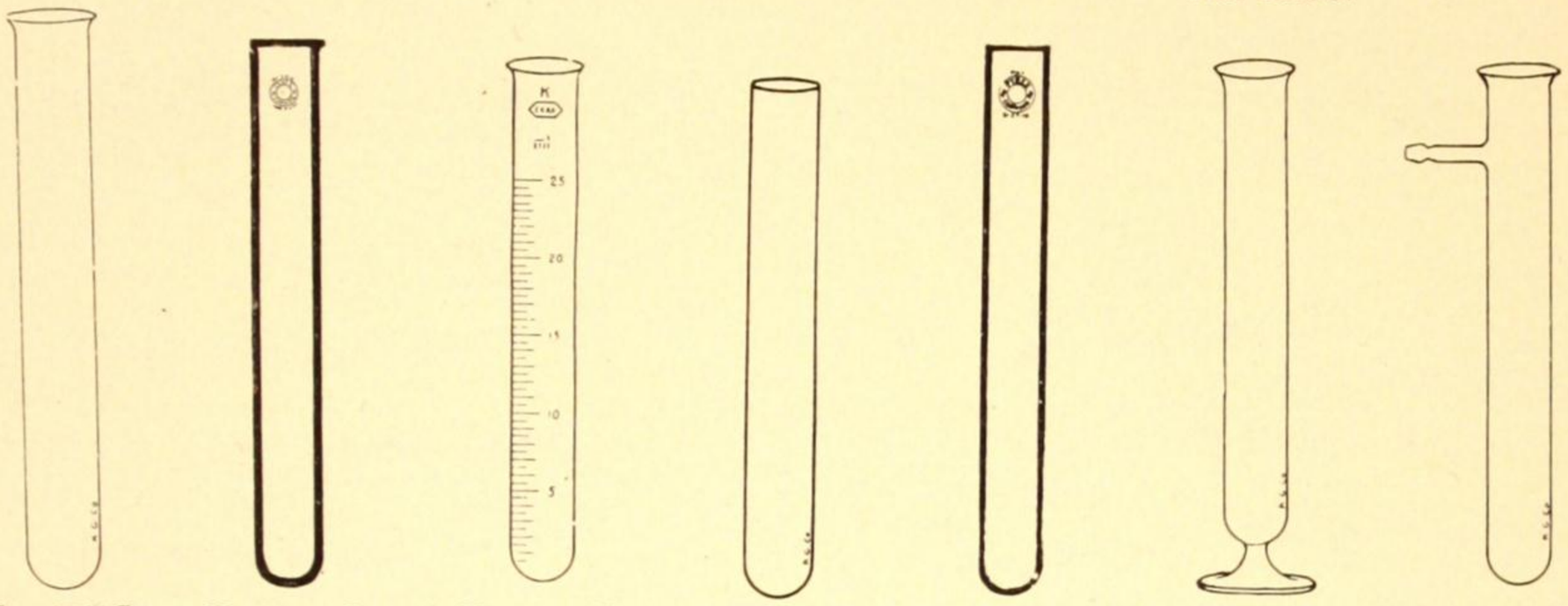


No. 1625C.

1637C. Test Glasses. Conical form with lip, ungraduated, clear white glass.

Capacity, cc.	30	60	125	200	250
Each	**$0.25**	**.30**	**.40**	**.45**	**.55**

Test Tubes



No. 1640C. No. 1646C. No. 1650C. No. 1655C. No. 1660C. No. 1665C. No. 1670C.

1640C. Test Tubes. Glass, thin wall, with lip, well annealed, free from lead. Standard grade for laboratory use.

Length, inches	3	4	5	6	6	6	7	8
Diameter, inches	⅜	½	⅝	⅝	¾	1	⅞	1
Per dozen	**$0.25**	**.27**	**.30**	**.32**	**.35**	**.50**	**.65**	**.75**
Per gross	**2.50**	**2.70**	**3.00**	**3.15**	**3.50**	**5.00**	**6.50**	**7.50**

1645C. Test Tubes, Assorted. Same as No. 1640C, assorted sizes from 3 to 7 inches. **Per doz.** **$0.40**

1646C. Test Tubes, Pyrex Glass. Thin wall, with rim. 10% discount when ordered in original package.

Length, mm.	100	125	150	150	175	200
Diameter, mm.	13	15	16	18	22	25
Number in original package	1008	1008	840	840	600	360
Each	**$0.04**	**.05**	**.06**	**.07**	**.09**	**.15**

1650C. Test Tubes, Graduated. Glass, thin wall, with lip.

Capacity, cc.	10	20	30
Graduated to, cc.	1/10	1/10	1/5
Each	**$0.40**	**.45**	**.50**

1655C. Test Tubes, Ignition. Hard glass, thick wall, without lip, round bottom.

Length, inches	4	5	6	8
Diameter, inches	½	⅝	¾	1
Per dozen	**$0.75**	**.90**	**1.10**	**1.50**

1660C. Test Tubes, Ignition, Pyrex Glass. Thick wall, without rim, for combustion and ignition purposes. 10% discount when ordered in original cartons.

Length, mm.	100	125	150	200
Diameter, mm.	14	16	20	25
No. in original carton	600	600	360	360
Per dozen	**$1.20**	**1.44**	**2.40**	**3.60**

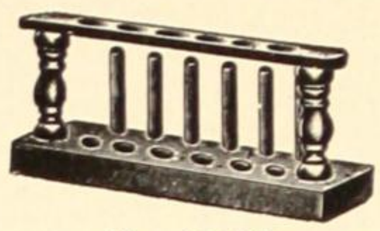
1665C. Test Tubes, on Foot. Glass, thin wall, with lip.

Length, inches	4	5	6	8
Diameter, inches	½	⅝	¾	1
Each	**$0.15**	**.16**	**.20**	**.25**
Per dozen	**1.50**	**1.60**	**2.00**	**2.50**

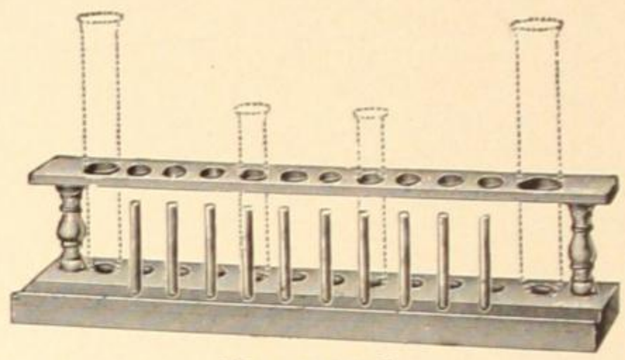
1670C. Test Tubes, Side Arm. Glass, with lip.

Length, inches	6	8
Diameter, inches	¾	1
Each	**$0.13**	**.18**
Per dozen	**1.30**	**1.80**

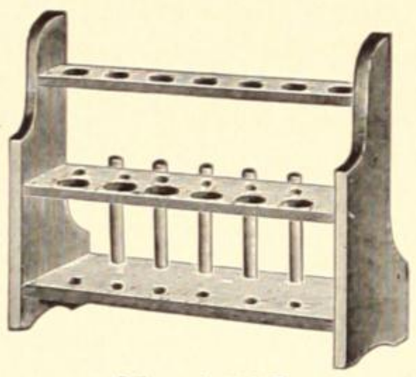
Test Tube Supports



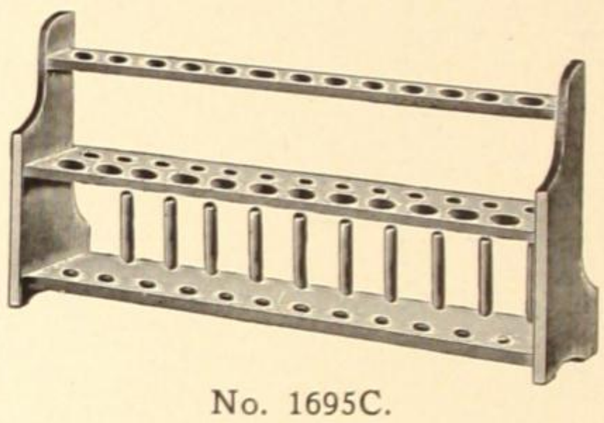
No. 1675C.



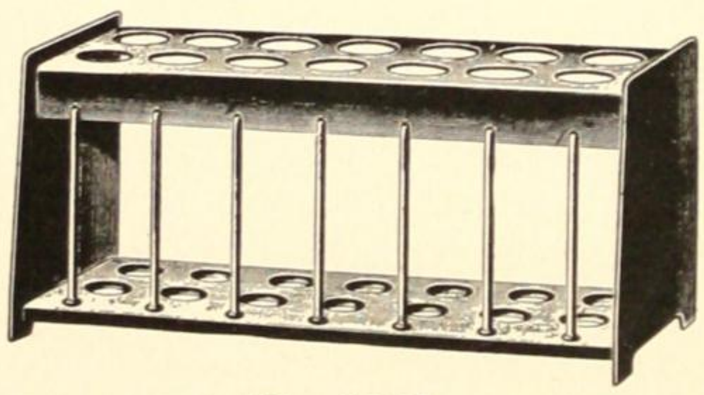
No. 1685C.



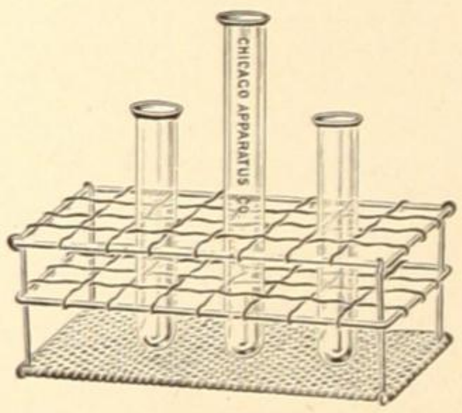
No. 1690C.



No. 1695C.



No. 1700C.



No. 1703C.

*1675C. **Test Tube Support, Hardwood.** With heavy base and six drying pins. For six tubes.....**$0.45**

*1680C. **Test Tube Support, Hardwood.** Same as No. 1675C, but with ten drying pins. For ten tubes **$0.65**

*1685C. **Test Tube Support, Hardwood.** Heavy base, ten holes for ¾-inch tubes, two for 1-inch tubes, ten drying pins, and groove in base for draining or holding stirring rods, pipettes, etc. **$0.75**

*1690C. **Test Tube Support, Hardwood.** With two shelves and six drying pins. For 13 test tubes..**$0.65**

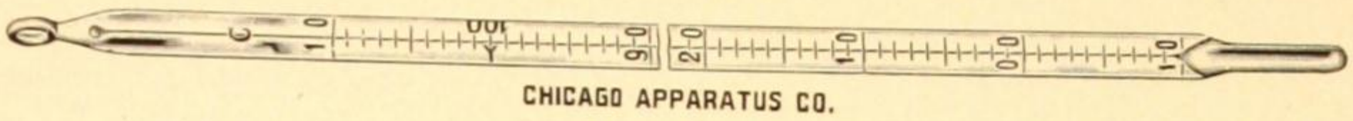
*1695C. **Test Tube Support, Hardwood.** Same as No. 1690C, but for twenty-five test tubes.....**$1.10**

*1700C. **Test Tube Support, Metal.** Stamped steel, black enameled, with seven drying pins. For fourteen test tubes **$0.65**

*1703C. **Test Tube Support, Wire.** The "double-deck" construction holds even the smallest tubes vertical. The frame is of heavy $\frac{3}{16}$-inch wire, making the support very strong and rigid. Tinned-after-making provides a heavy protective coating, solders all crossings together and materially increases the life of the support. Will hold 32 tubes up to 1 inch in diameter. Size, 9½x4½x3½ inches high.....**$1.00**

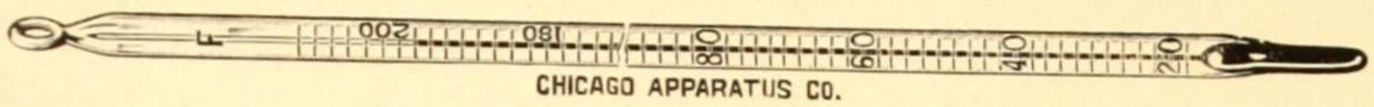
*20% discount in lots of 50.

Thermometers



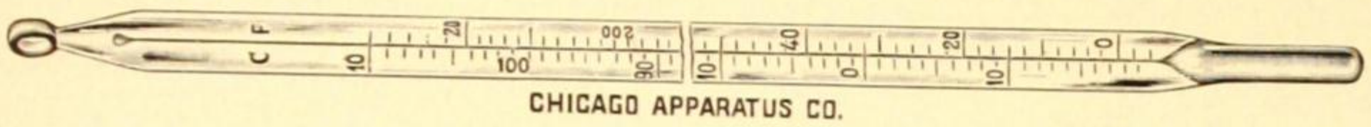
CHICAGO APPARATUS CO.

No. 1805C.



CHICAGO APPARATUS CO.

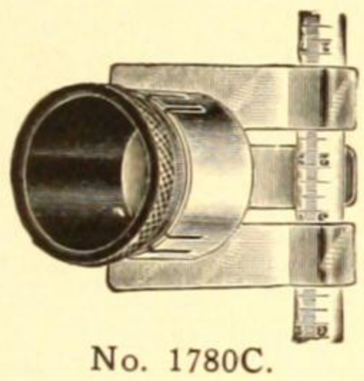
No. 1815C.



CHICAGO APPARATUS CO.

No. 1825C.

1780C. Thermometer Reading Device. Convenient for reading closely graduated thermometers, and for estimating fractions of divisions. Powerful magnifying lens in nickel silver mount with adjustable clips for thermometers 6 to 16 mm. in diameter.....**$3.00**



No. 1780C.

***1805C. Thermometers, Engraved Stem, Centigrade.** Diameter of stem about ¼ inch. Graduated in 1° divisions.

Cat. No.	1805C	1806C	1807C	1808C	1809C
Range, deg. C.	—10 to 110	0-150	0-200	0-250	0-360
Length, inches	12	12	14	14	16
Each	**$1.00**	**1.20**	**1.35**	**1.50**	**1.75**

***1815C. Thermometers, Engraved Stem, Fahrenheit.** Same as No. 1805C, but graduated in Fahrenheit scale, in 2° divisions.

Cat. No.....	1815C	1816C	1817C
Range, deg. F.....	10 to 220	30 to 400	30 to 650
Length, inches	12	14	16
Each	**$1.00**	**1.35**	**1.75**

***1825C. Thermometers, Engraved Stem, F. & C.** Same as No. 1805C, but with double scale.

Cat. No.....	1825C	1826C	1827C
Range, deg. C. .....—	10 to 110	0 to 200	0 to 350
Range, deg. F.....	10 to 220	30 to 400	30 to 650
Each	**$1.25**	**1.60**	**2.00**

***1828C. Thermometers, Engraved Stem, Centigrade.** Solid stem with fractional divisions. For general laboratory work not requiring the highest degree of precision.

No.	A	B	C	D
Range, deg. C.	0-50	0-100	0-100	0-200
Subdivisions, deg. C. .	1/10	1/5	1/10	1/5
Length, inches	15	16	24	24
Each	**$4.75**	**5.00**	**6.25**	**6.25**

3525B. Thermometer, Clinical, One Minute. First grade, with magnifying tube, in hard rubber case **$1.50**

1829CA. Thermometers, Engraved Stem, Centigrade. Filled with nitrogen above the mercury. Sealed for total immersion. Diameter, about 7 mm.; length, about 40 cm. Range 0-360° C., in 1° divisions. Accuracy about 1% **$3.00**

1829Cb. Thermometer, Engraved Stem, Centigrade. Same as No. 1829CA, but with range 100-500° C., in 2° divisions. Diameter, about 7 mm.; length, about 40 cm. Accuracy about 1%. Suitable for intermittent use only at temperatures above 450° C., because of the tendency of the glass to soften at higher temperatures. **Each** **$5.00**

1829Cc. Thermometer, Engraved Stem, Fahrenheit. Same as No. 1829CA, but with range 200-750° F., in 5° divisions. Diameter, about 7 mm.; length, about 40 cm. Accuracy, about 1%.....**$3.00**

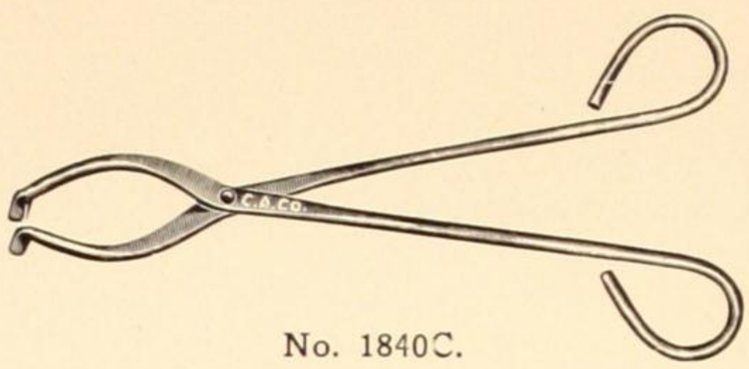
1829Cd. Thermometer, Engraved Stem, Fahrenheit. Same as No. 1829CA, but with range 200-900° F., in 5° divisions. Diameter, about 7 mm.; length, about 40 cm.; accuracy about 1%. Suitable for intermittent use only at temperatures above 750° F., because of the tendency of the glass to soften at higher temperatures **$5.00**

1829Ce. Thermometer, Engraved Stem, Centigrade, Low Range. For low temperatures. Alcohol filled. Range minus 50° to plus 50° C., in 1/5° divisions. Diameter, about 8 mm.; length, about 30 cm....**$4.00**

1829Cf. Thermometer, Engraved Stem, Centigrade, Low Range. For low temperatures. Toluol filled. Range minus 100° to plus 50° C., in 1° divisions. Diameter, about 10 mm.; length, about 30 cm. **$7.00**

1829Ch. Thermometer, Engraved Stem, Centigrade, Low Range. For very low temperatures. Pentane filled. Range minus 200° to plus 20° C., in 1/5° divisions. Diameter, about 10 mm.; length, about 35 cm. **$14.00**

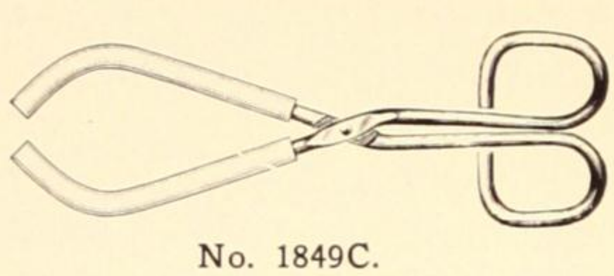
***20% discount in lots of 50.**



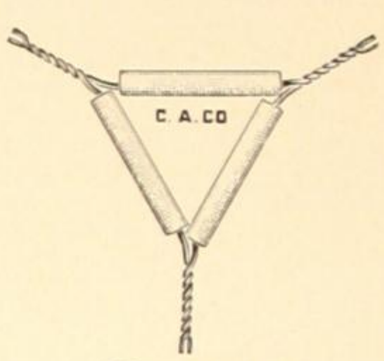
No. 1840C.



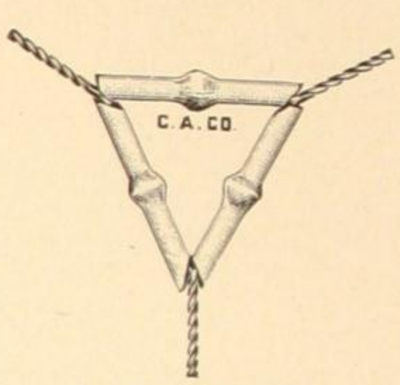
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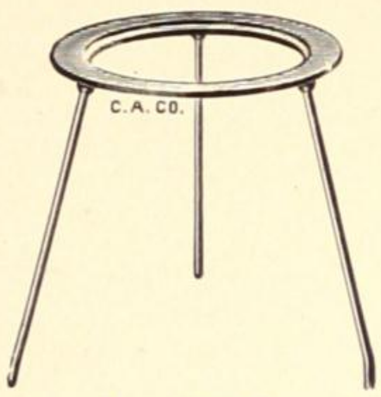
No. 1849C.



No. 1870C.



No. 1875C.



No. 1880C.



No. 1885C.



No. 1895C.

*1830C. **Tongs, Crucible.** Double bent. Brass. Riveted joint; length, 9 inches **$0.30**

*1835C. **Tongs, Crucible.** Double bent. Brass. Nickel-plated, riveted joint; length, 9 inches..... **$0.40**

*1840C. **Tongs, Crucible.** Double bent. Steel. Riveted joint; length, 9 inches. Parker rustproof finish **$0.25**

*1845C. **Tongs, Crucible.** Double bent. Steel. Nickel-plated, riveted joint; length, 9 inches..... **$0.40**

1847C. **Tongs, Steel.** Double bent. Forged with box joint, nickel-plated, 9 inches long. Superior quality **$1.50**

1849C. **Tongs, Beaker, Craig's.** For handling any size beaker from 50 to 2000 cc. Of rigid steel rod, nickel-plated, with rubber covered jaws.
Length, 9 inches **$0.60**

1860C. **Tray, Glass, Heavy.** Depth, 1½ inches.

No.	A	B	C
Size, inches	4½x5½	5½x8½	8½x10½
Each	**$0.35**	**.50**	**1.00**

1865C. **Triangles, Iron Wire.** Twisted, but not covered.

Length of side, inches	1½	2	2½
Each	**$0.08**	**.08**	**.08**

1870C. **Triangles, Pipestem.** Iron wire, covered with plain pipestems.

Length of side, inside, inches	1½	2	2½
Each	**$0.12**	**.12**	**.12**

1875C. **Triangles, Pipestem, Raised Centers.** Iron wire covered with raised center pipestems.

Length of side, inside, inches.	2	2½	3⅛
Each	**$0.15**	**.15**	**15**

*1880C. **Tripod, Iron.** Finished in black japan, with three easily removable legs. Height, 8⅝ inches.

Outside diameter, inches	5	6	8	10
Each	**$0.45**	**.55**	**.80**	**1.00**

*1885C. **Tripod, Iron.** Same as No. 1880C, but with Concentric Rings.

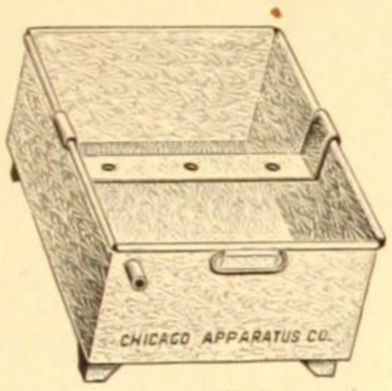
Outside diameter of tripod, inches	5	6	8	10
Number of rings	2	3	4	5
Each	**$0.55**	**.75**	**1.25**	**2.00**

*1890C. **Tripod, Iron.** Finished in black japan. For use with alcohol lamps. Outside diameter, 4 inches; height, 5½ inches **$0.35**

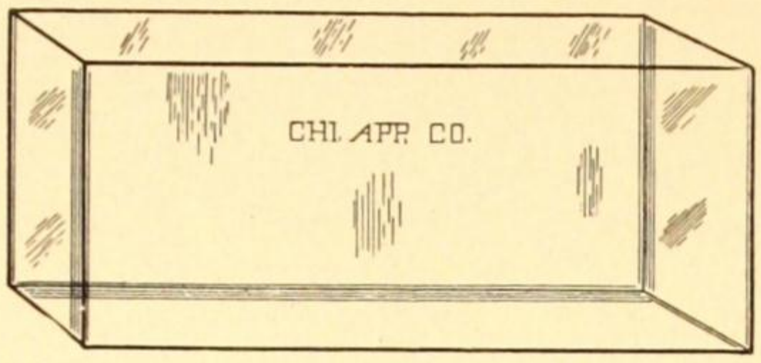
*1895C. **Tripod, Iron.** Finished in black japan. With adjustable lamp bracket. For use with alcohol lamps. Outside diameter, 5 inches· neight, 8⅝ inches.. **$0.80**

*1900C. **Lamp Bracket Only,** of No. 1895C. Will fit tripods 4 and 5 inches in diameter..... **$0.40**

***20% discount in lots of 50.**



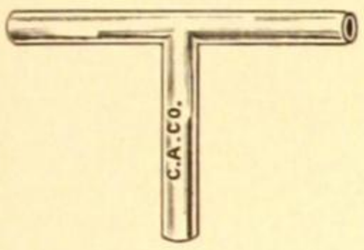
Nos. 1905C-1910C.



No. 595B.



No. 1912C.



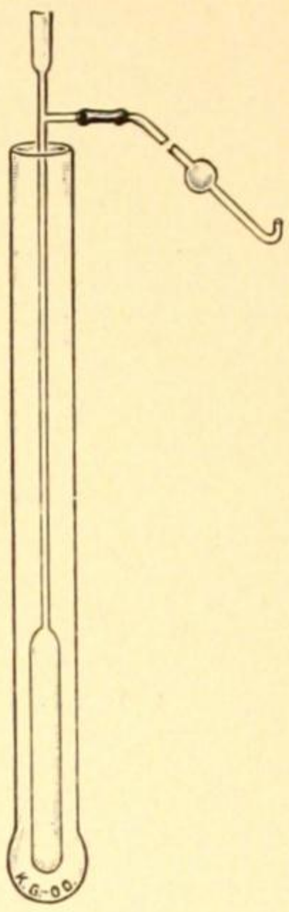
No. 1925C.



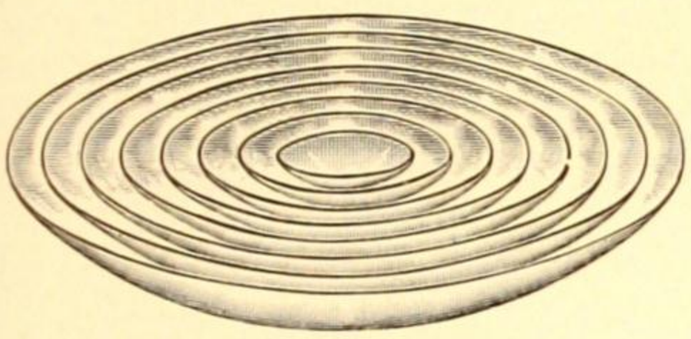
No. 1930C.



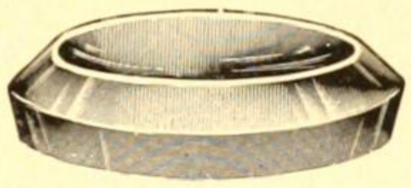
No. 1935C.



No. 1940C.



No. 1960C.



No. 1965C.

1905C. Trough, Pneumatic, Galvanized Iron. Heavy, with sliding shelf and overflow, 5x9x12 inches. . **$1.25**

1910C. Trough, Pneumatic, Galvanized Iron. Student's size—4½x7x10 inches—with sliding shelf and overflow. Far more durable and serviceable than the old style. Japanned tin trough..... **$0.80**

595B. Troughs, Pneumatic, Glass. Made of heavy clear flint glass. Excellent for lecture purposes. May also be used as aquaria.

No.	A	B	C
Capacity, liters	2.9	3.6	6.0
Length, cm.	20	25	30
Width, cm.	12	15	16
Height, cm.	12	15	16
Each	$2.50	3.50	4.50

1912C. Beehive Support. For use with pneumatic troughs, for supporting inverted bottles in which gas is collected. Made of zinc, 3 inches in diameter **$0.65**

1915C. Tubes, Connecting, Brass. T-shape.

Cat. No.	1915C	1916C
Diameter, outside, inches	5/16	3/8
Approx. length of arms, inches	1¾	1¾
Each	$0.35	.45

1920C. Tubes, Connecting, Brass. Y-shape.

Cat. No.	1920C	1921C
Diameter, outside, inches	5/16	3/8
Approx. length of arms, inches	1¾	1¾
Each	$0.35	.45

1925C. Tubes, Connecting, Glass. T-shape.

Cat. No.	1925C	1926C	1927C	1928C	1929C
Diameter, outside, mm.	5	7	8	10	12
Approx. lgth. of arms, mm.	50	50	60	75	100
Each	$0.15	.16	.17	.18	.20

1930C. Tubes, Connecting, Glass. U-shape.

Cat. No.	1930C	1931C	1932C	1933C	1934C
Diameter, outside, mm.	5	7	8	10	12
Approx. lgth. of arms, mm.	50	50	60	75	100
Each	$0.15	.16	.17	.18	.20

1935C. Tubes, Connecting, Glass. Y-shape.

Cat. No.	1935C	1936C	1937C	1938C	1939C
Diameter, outside, mm.	5	7	8	10	12
Approx. lgth. of arms, mm.	50	50	60	75	100
Each	$0.15	.16	.17	.18	.20

1941C. Tubes, Connecting, Lead. Y-shape. Outside diameter, 8 mm.; inside diameter, 5 mm.; length of arms, 38 mm. **$0.40**

1940C. Vapor Density Apparatus. Victor Meyer, complete with outer jacket of glass, 25 inches long by 1½ inches in diameter; inner tube of glass, 33 inches long; without test bottle..... **$3.00**

1945C. Bottle, small, glass stoppered, for use with No. 1940C **$0.50**

1950C. Inner Tube only for No. 1940C, with side arm **$1.25**

1955C. Outer Tube only of No. 1940C **1.50**

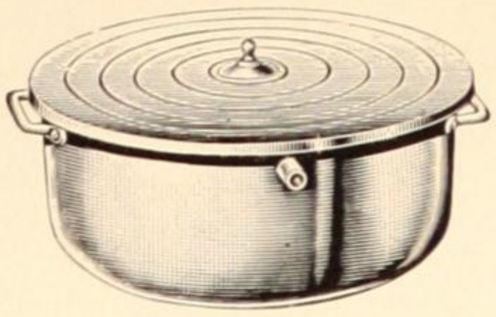
1960C. Watch Glasses. Well annealed, with edges ground smooth.

Diameter, inches	1½	2	2½	3
Per dozen	$0.40	.50	.60	.75
Diameter, inches	3½	4	5	6
Per dozen	$1.00	1.10	1.50	1.80

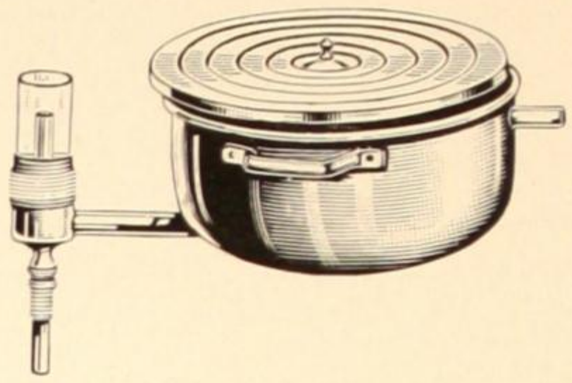
1965C. Watch Glasses, Syracuse. Plain, outside diameter 65 mm., inside diameter 50 mm. Grooved underneath to facilitate stacking. **Per dozen**.... **$1.20**

1970C. Watch Glasses, Syracuse. Same as No. 1965C, but with beveled surface ground for writing. **Per dozen** **$1.50**

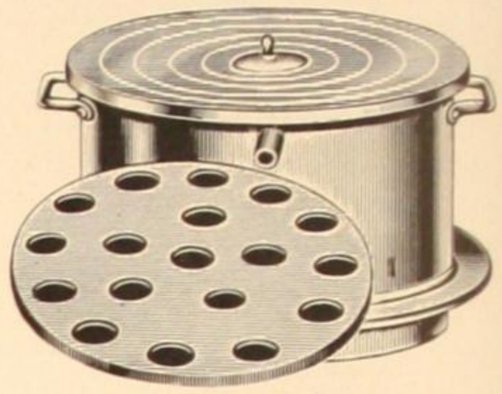
1975C. Watch Springs. For burning in oxygen, 5/32 inch wide, 12 inches long. **Per dozen** **$0.25**



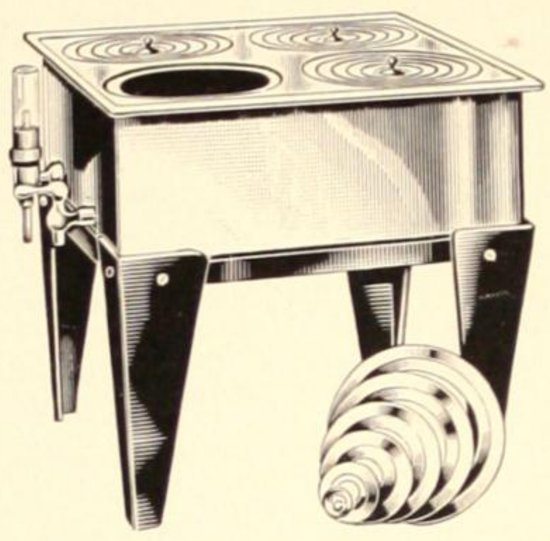
No. 1980C.



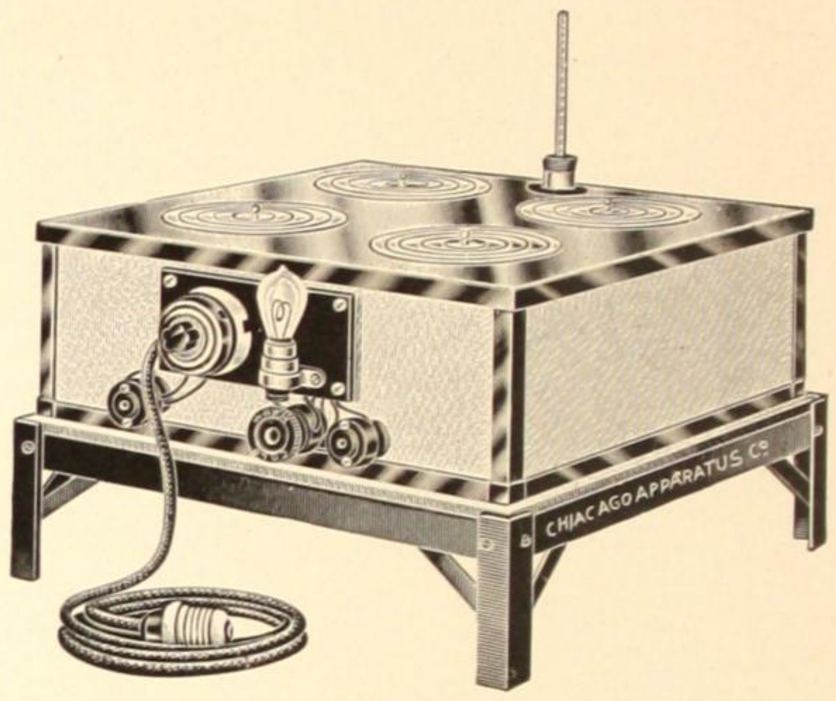
No. 1990C.



No. 1995C.



No. 2000C.



No. 2010C.

Water Baths

*1980C. **Water Baths.** Polished copper, tin lined, with concentric copper rings and cover, handles and steam escape.

Diameter, inches	4	5	6	8
Number of rings	3	4	5	6
Each	$1.45	1.75	2.25	3.75

*1990C. **Water Baths.** Same as No. 1980C, but with constant water level.

Diameter, inches	4	5	6	8
Number of rings	3	4	5	6
Each	$2.50	2.75	3.50	5.00

*1995C. **Water Baths.** Polished copper, tin lined, with concentric copper rings and cover, handles and steam escape, as well as extra copper perforated plate for test tubes.

Diameter, inches	6	8
Number of tube holes in plate	12	18
Each	$5.00	8.50

2000C. **Water Baths, Rectangular.** Polished copper, tin lined, with concentric rings and steam cover, stopcock for draining, constant water level regulator. With extra sheet iron bottom and supported on four detachable legs. Size, 14x14x5 inches deep. Four openings, 5 inches in diameter.....$21.00

2005C. **Water Baths, Rectangular.** Same as No. 2000C, but with coil to be heated by steam....$30.00

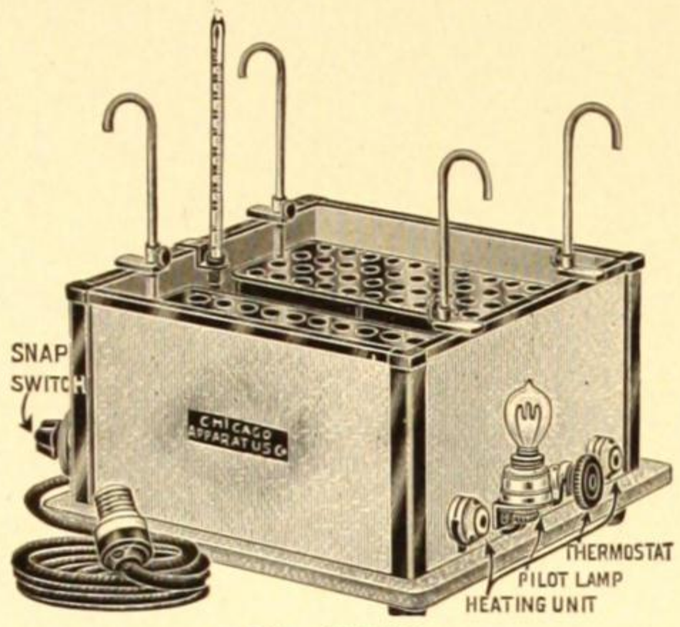
2010C. **Water Baths. Electrically Heated and Controlled.** Concentric Ring type. Heavy copper, tinned on the inside; sides and bottom covered on outside with thick insulating material to prevent radiation. A snap switch, controlling part of the heat units, is provided for rapid changes in temperature of bath. Pilot light indicates when current is on or off. Top has four 5-inch openings. Inside dimensions 14x-14x5 inches deep.

Furnished complete with 4-inch iron stand and centigrade thermometer. (In ordering specify voltage of electric current on which apparatus is to be used).....$100.00

2015C. **Water Baths. Electrically Heated and Controlled.** Concentric Ring type. Same general construction as No. 2010C. Inside dimensions 9x9x5 inches deep. Removable top has one 5-inch, one 4-inch and two 2½-inch openings.

Furnished complete, with centigrade thermometer. (In ordering specify voltage of electric current on which apparatus is to be used).....$69.00

*10% discount in lots of 12.



No. 2020C.

2020C. Water Bath. Electrically Heated and Controlled. Constant temperature. Inside dimensions 9x9x5 inches deep. Heavy copper, tinned on inside and covered on outside with thick insulating material to prevent radiation. Heat units are placed in metal tubes at the bottom of bath, and a pencil type thermostat is installed parallel with the heat units for the regulation of the temperature. Pilot lamp indicates when current is on or off. Snap switch controls part of the heat units for the purpose of changing the temperature of the bath from 37½° C. to 56° C., if such change should be desired.

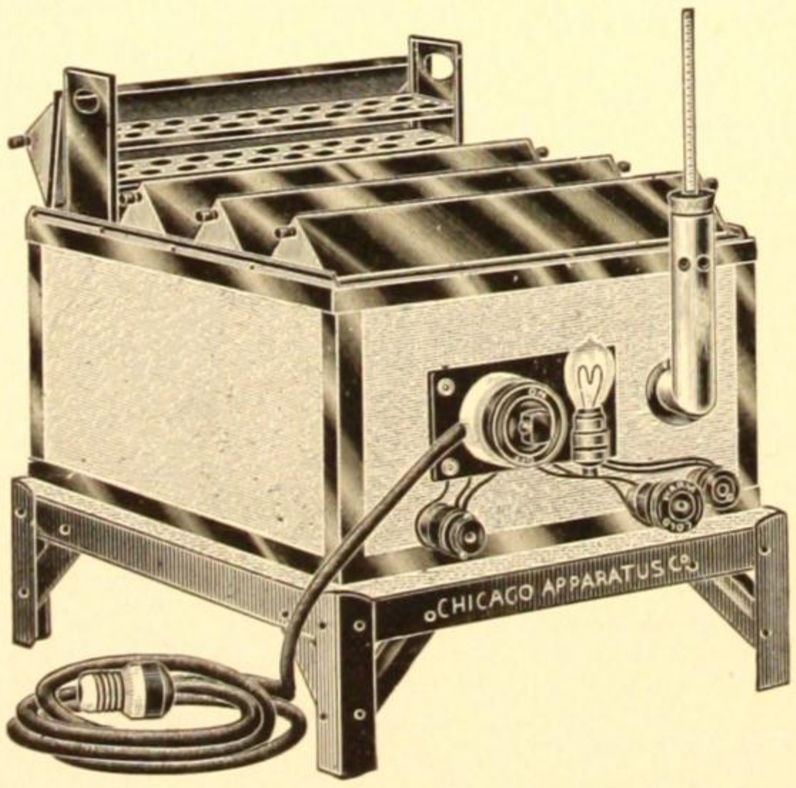
Furnished with two No. 2045C test tube racks, each having a capacity of 48 test tubes 3x⅜ inch in size. Maximum current consumption, 2¼ amperes. (In ordering specify electric current on which apparatus is to be used, mentioning voltage, whether direct or alternating, and if alternating, the number of cycles) **$65.00**

2025C. Water Bath, Gable Type. Electrically Heated. Made from heavy copper, tinned on the inside; the sides and bottom of the baths are covered on the outside with a thick insulating material to prevent radiation. As will be seen from the illustration, the baths are equipped with hinged gables, as a protection from dust and to minimize the evaporation of the water, permitting the condensed water to drip back into the bath. The test tube racks furnished have a capacity of 20 test tubes of 4x½ inch size. Each pair of holes is numbered consecutively from 1 to 10.

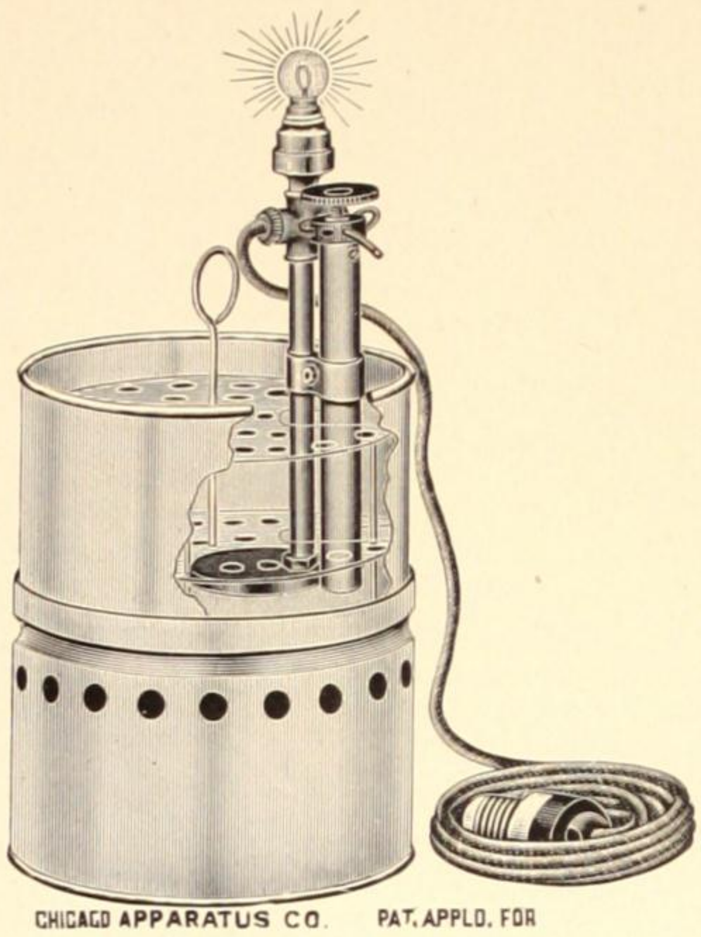
A pencil type thermostat provides for regulation of the temperature. A pilot lamp indicates when the current is on or off. Snap switch controls part of the heat units, for the purpose of changing the temperature of the bath from 37½° C. to 56° C., if such change should be desired.

(On orders for electric water baths specify electric current on which apparatus is to be used, mentioning voltage, whether direct or alternating current, and if alternating, the number of cycles.)

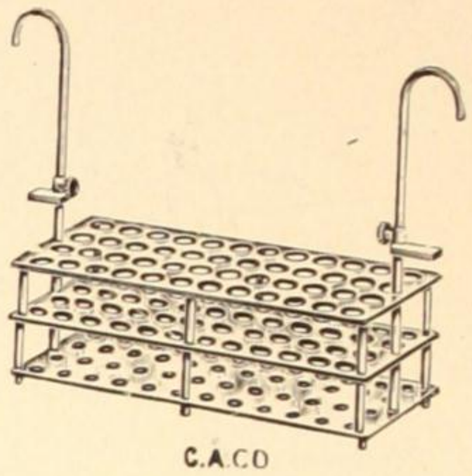
Cat. No.	2025C	2028C
No. of racks	4	6
Length, inches	13¼	19¾
Width, inches	10½	10½
Depth, inches	6	6
Stand, height, inches	4	4
Max. current, amp.	2¼	2½
Capacity, tubes	80	120
Each	**$85.00**	**105.00**



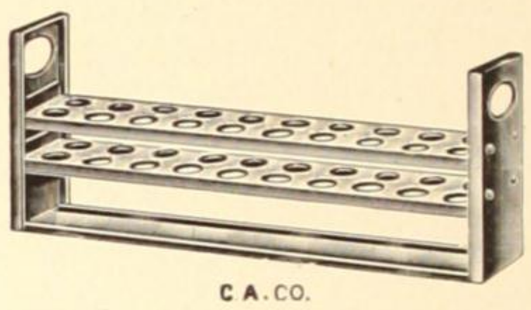
No. 2025C.



No. 2033C.



No. 2045C.



No. 2050C.



Nos. 2065C-2070C.



No. 2075C.

2033C. Water Bath, Electrically Heated. Constant temperature. Consists of a cylindrical, tinned copper bath with inside dimensions 6″ diam. x 4″ deep, together with Russia iron base 4″ high. Furnished with test tube rack with 28 tabulations, ⅜ inch in diameter. Heating unit consists of an electric heating disk 5″ diam. x ½″ thick, with pencil type thermostat, pilot lamp, cord and plug. Maximum current consumption, 1 ampere. (In ordering specify electric current on which the apparatus is to be used, mentioning voltage, whether direct or alternating, and if alternating, the number of cycles) **$46.00**

2035C. Water Bath Only of No. 2033C **10.00**

2040C. Electric Heating Unit Only of No. 2033C **36.00**

2045C. Water Bath Test Tube Rack. Size, 9x4x2½ inches high; height overall, 8 inches. Made from nickeled brass, with adjustable supports for suspending in bath, and furnished with two shelves, as shown in illustration. Capacity, 48 test tubes 3x⅜ inch **$5.50**

2050C. Water Bath Test Tube Rack. Standard U. S. Army type. Capacity, 20 test tubes, 4 inches by ½ inch in size. Made from polished copper and furnished with two shelves as shown in illustration. Each pair of holes is numbered consecutively from 1 to 10. Dimensions of rack, 10¼ inches by 2¼ inches by 4⅜ inches **$3.00**

2065C. Wire Gauze. Brass. 20 mesh, in squares, for use under dishes, etc.

Size, inches	4x4	5x5	6x6	12x12
Each	$0.12	.15	.25	.65
Per dozen	1.20	1.50	2.50	6.50

2070C. Wire Gauze, Iron Galvanized, Milvay. Extra strong long-service gauze squares. Made from No. 26 gauge galvanized iron wire woven to 16 mesh. Will support more weight with less sag than lighter gauge and finer mesh gauzes. Remarkable flame resistance—3 times tinned iron wire gauze—4½ times plain iron wire gauze.

Size, inches	4x4	5x5	6x6	12x12
Each	$0.05	.07	.10	.30
Per dozen	.50	.70	1.00	3.00

2075C. Wire Gauze with Asbestos Center, Milvay. Extra strong long-service squares with long-fiber asbestos circles imbedded in their centers by the power press method. This method was originated by us more than fifteen years ago. It enabled, for the first time, the fabrication of a product superior to the asbestos paste center gauze then standard. Milvay now offers a further improvement—a stronger, stiffer and more durable supporting gauze for the asbestos center. It is made from 26 gauge galvanized iron wire woven to 16 mesh. It offers the following advantages over the coarse 8 to 12 mesh gauze ordinarily employed.

It prevents the flame from striking through and burning above the gauze. It supports more weight. It has greater flame resistance. It gives much longer service. It does not unravel at the edges. Samples for comparative test free on application.

Size, inches	4x4	5x5	6x6
Diameter, asbestos center, inches	3½	3½	3½
Each	$0.10	.12	.15
Per dozen	1.00	1.20	1.50

CHEMICALS AND REAGENTS



IMMEDIATE DELIVERY OF CHEMICALS

OUR stock of chemicals is most complete and because we carry all of the standard size packages on our shelves in large quantities, we are in a position to offer immediate delivery service on orders placed with us. Also, our stock is so arranged that a minimum of time is required for filling and dispatching orders. Further, because of the quantity and quality of chemicals we handle, the purchasing of your chemical needs from us assures you, in addition to prompt service, economy and satisfactory supplies. We have never used paper bags in packaging chemical, all of our packages being either bottles, tins, or wax-lined cartons, the latter being used only for dry technical chemicals. All C. P. chemicals are in original bottles bearing the manufacturer's label.

Chemicals and Reagents

ON this and succeeding pages, we present a carefully compiled and comprehensive list of chemicals, stains. solutions, test papers, volumetric solutions, etc., that we carry in stock for immediate delivery. The quality technical chemicals that we handle have given the utmost satisfaction for over twenty-two years, and as heretofore they are carefully selected from the leading American and foreign manufacturers; thus representing the best the market affords.

The term C. P. has been used very indiscriminately by many to designate goods of a somewhat higher quality than the ordinary commercial grade. We apply the term C. P. only to such goods as are suitable for all general analytical purposes where practical freedom from chemical contamination is essential. All of our C. P. chemicals are furnished in the original manufacturer's package and with the label of the manufacturer showing the purity of the chemical contained therein.

As far as possible we supply Baker & Adamson C. P. chemicals. The Baker & Adamson Company is a division of the General Chemical Corp. and have gained an enviable reputation for quality. To their guarantee of quality we unconditionally add our own guarantee that any chemicals purchased from us will be entirely satisfactory in every respect.

The C. P. chemicals that we cannot procure from the Baker & Adamson Company are those of standard manufacturers and as in the case of B. & A. chemicals are likewise supplied in the original packages of the manufacturer.

We have priced our chemicals only in the size packages which we regularly carry in stock. Because of quantity production the buying of chemicals in these standard packages represents real economy and we can also ship orders without delay from our large stock. The prices indicated are correct at the time of printing and are subject to market changes without notice. All of our prices include containers except in the case of carboys and ten bottle acid cases. These are charged at actual cost and are returnable for full credit when shipped to us in good condition, transportation charges prepaid.

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Acetamide cryst. pure	**$0.40**	**$1.00**	**$3.00**	.....
Acetanilide powd., U. S. P	....	**.25**	**.75**	.....
Acetic Anhydride (Acetic oxide) Pure	**.25**	**.45**	**1.15**	.....
" " " " **C. P.**	**.35**	**.65**	**1.60**	.....
Acetone, U. S. P	....	**.25**	**.55**	**$2.25**
" **C. P.**	....	**.30**	**.60**	**3.00**
Acetyl Chloride	**.45**	**.85**	**2.25**	.....
" **Oxide**—see Acetic Anhydride	....	....	....	.....
Acid Acetic 30% **C. P.**	....	**.25**	**.40**	**1.55**
" " 99—99.5% Glacial pure	....	**.30**	**.50**	**2.00**
" " 99—99.5% " **C. P.**	....	**.35**	**.70**	**2.60**
" " Anhydride—see Acetic Anhydride	....	....	....	.....
" **Anthranilic** refined	**.35**	**1.00**	**3.00**	.....
" **Arsenic** dry tech	**.25**	**.40**	**1.15**	.....
" " **C. P.**	**.30**	**.50**	**1.50**	.....
" **Arsenous** powd. tech	....	**.20**	**.30**	**1.25**
" " " **C. P.**	**.20**	**.40**	**.80**	.....
" " lump U. S. P	**.25**	**.45**	**.85**	.....
" **Benzoic** from Toluene U. S. P	**.25**	**.45**	**1.30**	.....
" " " " **C. P.**	**.30**	**.70**	**2.00**	.....
" **Boric** cryst. U. S. P	....	**.20**	**.30**	**1.25**
" " " **C. P.**	**.20**	**.35**	**.65**	.....
" " powd. U. S. P	....	**.20**	**.30**	**1.25**
" " " **C. P.**	**.20**	**.40**	**.75**	.....
" " Anhydride (fused)	**.25**	**.70**	**2.00**	.....
" " " " powd	**.25**	**.70**	**2.00**	.....
" **Butyric** 60%	**.30**	**.55**	**1.65**	.....
" " absolute pure	**.35**	**.70**	**2.15**	.....
" **Carbolic** white cryst. U. S. P	....	**.30**	**.60**	**2.60**
" " " loose cryst. **C. P.**	**.20**	**.40**	**1.00**	**4.50**
" " liquid U. S. P	....	**.30**	**.60**	**2.60**
" **Chromic** (Chromium Trioxide) 98% tech	**.25**	**.50**	**1.25**	.....
" " " " 85% cryst. pure	**.30**	**.70**	**1.55**	.....
" " " " **C. P.**	**.35**	**.70**	**2.20**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Acid Citric cryst. U. S. P.	**$0.20**	**$0.35**	**$1.00**	.....
" " " **C. P.**	**.25**	**.50**	**1.30**	.....
" **Cresylic**—see Cresol	....	....	....	.....
" **Dichloracetic**	**.60**	....	....	.....
" **Formic** 25% tech	**.20**	**.35**	**.60**	.....
" " " **C. P.**	**.25**	**.40**	**.75**	**$2.50**
" " 50% pure	**.25**	**.35**	**.70**	.....
" " 85% tech	**.25**	**.40**	**.80**	.....
" " 85—90% **C. P.**	**.30**	**.50**	**1.25**	.....
" **Gallic** cryst. U. S. P.	**.25**	**.50**	**1.40**	.....
" **Gallic C. P.**	**.30**	**.60**	**1.65**	.....
" **Hydrobromic** 10% U. S. P.	**.20**	**.35**	**.60**	.....
" " 34% pure	**.30**	**.65**	**1.35**	.....
" " 40% **C. P.**	**.35**	**.60**	**1.50**	.....
" **Hydrochloric** tech	....	....	**.45**	6 lb. **1.15**
" " " " 110 lb. carboy	....	....	....	per lb. **.05**
" " (Carboy extra and returnable **5.00**)	....	....	....	.....
" " Sp. Gr. 1.20 **C. P.**	....	....	**.55**	6 lb. **1.60**
" " " " 1.20 **C. P.** Case of 10x6 lb. bottles **8.75**	....	....	....	.....
(Case and Bottles extra and returnable **5.50**)	....	....	....	.....
" " " " 1.20 **C. P.** 111 lb. carboy	....	....	....	per lb. **.11**
(Carboy extra and returnable **5.00**)	....	....	....	.....
" **Hydrocyanic,** diluted 2% U. S. P.	**.25**	**.40**	**.65**	.....
" " 5%	**.55**	....	....	.....
" **Hydrofluoric,** 52% tech. in ceresin bot	**.35**	**.60**	**1.10**	.....
" " 48% **C. P.** " " "	**.40**	**.70**	**1.40**	.....
" **Hydrofluosilicic,** tech. " " "	**.35**	**.70**	**1.25**	.....
" " **C. P.** " " "	**.45**	**.80**	**1.85**	.....
" **Hydroiodic** 10% dilute	**.35**	**.60**	**1.50**	.....
" " 45% **C. P.**	**.60**	**1.60**	....	.....
" **Iodic,** cryst. pure	**1.25**	....	....	.....
" " anhydride	**1.85**	....	....	.....
" **Lactic,** U. S. P. 75%	**.25**	**.50**	**1.30**	.....
" **Lactic** U. S. P. 85%	**.30**	**.60**	**1.50**	.....
" " **C. P.** 85%	**.35**	**.70**	**1.75**	.....
" **Maleic**	**.40**	**1.00**	**3.00**	.....
" **Malic**	**.35**	**.95**	**2.75**	.....
" **Malonic**	**1.50**	....	....	.....
" **Meta Phosphoric Sticks**—see Acid Phosphoric Stick	....	....	....	.....
" **Molybdic,** 85% **C. P.**	**.35**	**.90**	**2.50**	.....
" " Anhydride **C. P.**	**.45**	**1.15**	**3.50**	.....
" **Monochloracetic** cryst. pure	**.30**	**.50**	**1.35**	.....
" " " **C. P.**	**.35**	**.65**	**1.60**	.....
" **Mucic**	**.40**	**1.20**	....	.....
" **Muriatic**—see Acid Hydrochloric	....	....	....	.....
" **Nitric,** tech	....	....	**.55**	7 lb. **1.70**
" " " 130 lb. carboy	....	....	....	per lb. **.11**
(Carboy extra and returnable **5.00**)	....	....	**.70**	7 lb. **2.50**
" " sp. gr. 1.42 **C. P.**	....	....	....	.....
" " sp. gr. 1.42 **C. P.** case of 10x7 lb. bottles **15.00**	....	....	....	.....
(Case and Bottles extra and returnable **5.50**)	....	....	....	per lb. **.17**
" " sp. gr. 1.42 **C. P.** 135 lb. carboy	....	....	**1.00**	7 lb. **3.50**
(Carboy extra and returnable **5.00**)	....	....	**1.15**	7 lb. **4.50**
" " fuming white 1.50 tech	....	....	**1.40**	7 lb. **6.00**
" " " " 1.50 **C. P.**	....	....	**1.50**	7 lb. **6.50**
" " " red 1.60 tech	....	**.25**	**.55**	.....
" " " " 1.60 **C.P.**	....	**.30**	**.60**	.....
" **Oleic,** tech	....	....	....	½ Gm. **3.75**
" " clear U. S. P.	....	....	....	1 Gm. **7.25**
" **Osmic Anhydride,** cryst	....	**.20**	**.35**	**1.50**
" **Oxalic,** cryst. tech	**.20**	**.40**	**.80**	**3.75**
" " " **C. P.**	**.30**	**.65**	**1.80**	.....
" " Anhyd. **C. P.**	**.30**	**.70**	**2.00**	.....
" **Palmitic,** tech	**.30**	**.60**	**1.60**	.....
" **Perchloric,** sp. gr. 1.12—20% pure	**.40**	**.85**	**2.60**	.....
" " " " 1.54—60% **C. P.**	....	....	....	.....
" **Perosmic**—see Acid Osmic Anhyd	**1.00**	....	....	.....
" **Phosphomolybic** cryst. **C. P.**	**.30**	**.75**	**2.00**	.....
" " solut. 10%				

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Acid Phosphoric Anhydride	**$0.45**	**$0.70**	**$1.50**	3 lb. **$3.30**
" " Meta Glacial Sticks	**.30**	**.60**	**1.50**	.....
" " Ortho 85% pure	**.25**	**.45**	**.65**	**2.95**
" " " 85% **C. P.**	**.30**	**.55**	**1.00**	.....
" **Phosphorus,** cryst	**.45**	**1.25**	**3.75**	.....
" **Phosphotungstic,** cryst. **C. P.**	**.65**	**1.65**	....	.....
" " 10% solut	**.30**	**.70**	**2.00**	.....
" **Phthalic** Anhydride pure	**.25**	**.40**	**1.10**	.....
" " " **C. P.**	**.30**	**.50**	**1.40**	.....
" **Picric** pure 10% water added	**.30**	**.60**	**1.75**	.....
" " **C. P.**	**.35**	**.70**	**2.10**	.....
" **Propionic**	**.25**	**.55**	**1.50**	.....
" **Prussic**—see Acid Hydrocyanic	....	....	....	.....
" **Pyrogallic** cryst. U. S. P	**.35**	**.80**	**2.60**	.....
" **Pyrogallic** Resub. U. S. P	**.40**	**.95**	**3.10**	.....
" " " **C. P.**	**.50**	**1.20**	**3.50**	.....
" **Pyroligneous** pure	....	**.25**	**.50**	.....
" **Rosolic**	**1.00**	....	....	.....
" **Salicylic** U. S. P	**.20**	**.35**	**.80**	.....
" " cryst. **C. P.**	**.25**	**.55**	**1.25**	.....
" **Selenous** cryst. **C. P.**	**1.10**	**3.20**	....	.....
" **Silicic** pure	**.20**	**.40**	**1.15**	.....
" " precip. **C. P.**	**.25**	**.50**	**1.50**	.....
" **Stearic** lump tech	....	**.25**	**.45**	**2.00**
" " " U. S. P	....	**.30**	**.60**	.....
" " powd. U. S. P	....	**.30**	**.65**	.....
" **Succinic** cryst. pure	**.30**	**.75**	**2.25**	.....
" " " **C. P.**	**.40**	**1.15**	**3.25**	.....
" **Sulphanilic** white cryst	**.30**	**.80**	**2.25**	.....
" " **C. P.**	**.40**	**1.00**	**3.00**	.....
" **Sulphuric** tech	....	....	**.45**	9 lb. **1.25**
" " " 180 lb. carboy	....	....	....	per lb. **.05**
(Carboy extra and returnable **5.00**)	....	....	....	.....
" " sp. gr. 1.84 **C. P.**	....	....	**.55**	9 lb. **2.25**
" " " " 1.84 **C. P.** case of 10x9 lb. bottles, **12.75**	....	....	....	.....
(Case and Bottles extra and returnable, **5.50**)	....	....	....	.....
" " sp. gr. 1.84 **C. P.** 178 lb. carboy	....	....	....	per lb. **.11**
(Carboy extra and returnable, **5.00**)	....	....	....	.....
" " fuming, 15% SO_3, **C. P.**	....	....	**.90**	9 lb. **5.50**
" " " 30% SO_3, **C. P.**	....	....	**1.10**	9 lb. **6.00**
" " " 60% SO_3, tech	....	....	**1.00**	9 lb. **5.25**
" " Anhydride, 1-lb. bottles only	....	....	**1.60**	.....
" **Sulphurous,** 5-6%, **C. P.**	....	....	**.65**	**2.00**
" " Anhyd., 6-lb. cylinders with valve top, **7.50**	....	....	....	.....
" Tannic, tech. Powd. (Tannin)	**.20**	**.35**	**.85**	.....
" " U. S. P	**.25**	**.55**	**1.55**	.....
" " Soluble, **C. P.**	**.35**	**.70**	**1.95**	.....
" **Tartaric,** cryst., U. S. P	**.20**	**.35**	**.80**	**3.50**
" " " **C. P.**	**.25**	**.40**	**1.15**	.....
" " powd., **C. P.**	**.30**	**.45**	**1.25**	.....
" **Trichloracetic,** cryst., U. S. P	**.50**	**1.35**	....	.....
" **Tungstic,** tech	**.50**	**1.25**	**3.75**	.....
" " **C. P.**	**.60**	**1.65**	**5.00**	.....
" **Uric** (Uric Oxide)	**.95**	....	....	.....
" **Valerianic Trihydrated** (iso)	**.60**	....	....	.....
" **Vanadic,** Anhydride, **C. P.**	**1.30**	....	....	.....
Aesculin	....	....	....	10 Gm. **7.50**
Agar Agar, white shreds	**.35**	**.90**	**2.50**	.....
" " gran	**.40**	**1.20**	**3.50**	.....
" " " " Bacto	....	**1.50**	**4.75**	.....
" " powd	**.45**	**1.30**	**3.75**	.....
" " Nutrient Bacto	....	**2.50**	**8.50**	.....
Albumen, from blood	**.20**	**.50**	**1.25**	.....
" " eggs, cryst	**.25**	**.80**	**2.50**	.....
" " " " powd	**.30**	**.85**	**2.70**	.....
Alcohol Allyl	**.85**	....	....	.....
" **Amyl** (Fusel Oil)	**.20**	**.40**	**1.00**	.....
" " (iso) **C. P.**	**.25**	**.70**	**2.10**	.....
" " **Tertiary**—see Amylene Hydrate	....	....	....	.....
" **Benzyl**	**.30**	**.70**	**2.50**	.....
" **Butyl** normal pure	**.25**	**.50**	**1.25**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Alcohol Capryl pure	**$0.90**	**$3.00**	....	.....
" **Ethyl** denatured 95% pt. **.40** qt. **.60** ½ gal. **.90** 1 gal. **1.35**	....	....	....	5 gal. **$5.50**
" **Denatured** absolute 99-100% pt. **.50** qt. **.75** ½ gal. **1.10** 1 gal. **1.75**	....	....	....	5 gal. **8.00**
(NOTE—WE DO NOT SELL PURE ETHYL ALCOHOL)				
" **Methyl** tech. pt. **.40** qt. **.60** ½ gal. **1.00** 1 gal. **1.40**	....	....	....	5 gal. **6.00**
" " Acetone free **C. P.**	....	**.40**	**$0.85**	.....
" " Absolute synthetic pt. **.50** qt. **.75** ½ gal. **1.40**	....	....	....	1 gal. **2.00**
" **Propyl** normal pure	**.25**	**.60**	**2.15**	.....
" " (iso) **C. P.**	**.25**	**.50**	**1.50**	.....
" **Wood**—see Alcohol Methyl	....	....	....	.....
Aldehyde Acetic 50%	**.25**	**.55**	**1.60**	.....
" **Ammonia** cryst	**.55**	**1.60**	**5.00**	.....
" **Cinnamic**	**1.20**	**3.50**	....	.....
Alizarine dry—see Aniline Dyes	....	....	....	.....
" **Paste** about 20%	**.25**	**.70**	**1.75**	.....
Alkanet Root ground	**.20**	**.50**	**1.00**	.....
Alloys fusible Rose's M. P. about 95° C	**.40**	**1.10**	**3.25**	.....
" " Wood's M. P. about 60° C	**.40**	**1.10**	**3.25**	.....
" **Devarda's** for reduction	**.30**	**.75**	**2.25**	.....
Alphanaphthol—see Naphthol Alpha	....	....	....	.....
Alphanaphthylamine—see Naphthylamine Alpha	....	....	....	.....
Alum—see Aluminum Potassium Sulphate	....	....	....	.....
" **Ammonia**—see Aluminum Ammonium Sulphate	....	....	....	.....
" **Chrome**—see Chromium Potassium Sulphate	....	....	....	.....
" **Sodium**—see Aluminum Sodium Sulphate	....	....	....	.....
Aluminum Metal powd	**.25**	**.60**	**1.50**	.....
" " shot (punchings)	....	**.30**	**.65**	**2.75**
" " heavy sheet	**.20**	**.35**	**.95**	.....
" " light sheet	**.25**	**.45**	**1.35**	.....
" " stick	**.25**	**.60**	**1.60**	.....
" " turnings	**.20**	**.35**	**.65**	**2.75**
" " 20 mesh **C. P.**	**.25**	**.50**	**1.50**	.....
" " wire—see Section D	....	....	....	.....
" " leaf in books—see Section D	....	....	....	.....
" **Acetate** basic powd. pure	**.20**	**.40**	**1.20**	.....
" " **C. P.**	**.25**	**.60**	**1.70**	.....
" **Ammonium Sulphate** cryst	....	....	**.25**	**.80**
" " " " **C. P.**	....	**.30**	**.55**	**2.50**
" " " powd	....	....	**.25**	**.80**
" **Bromide C. P.**	**.75**	**2.15**	**6.40**	.....
" **Chloride** cryst. tech	....	**.30**	**.55**	**2.50**
" " " **C. P.**	**.20**	**.40**	**1.00**	.....
" " anhyd. Sublimed **C. P.**	**.30**	**.55**	**1.60**	.....
" **Chromate C. P.**	**.55**	**1.65**	**5.00**	.....
" **Fluoride C. P.**	**.30**	**.60**	**1.85**	.....
" **Hydrate** pure	....	**.30**	**.55**	**2.50**
" " **C. P.**	**.20**	**.40**	**.95**	.....
" **Nitrate** cryst. **C. P.**	**.20**	**.45**	**1.05**	.....
" **Oxide** anhyd. **C. P.**	**.20**	**.45**	**1.05**	.....
" **Phosphate C. P.**	**.25**	**.55**	**1.65**	.....
" **Potassium Sulphate** cryst	....	....	**.25**	**.80**
" " " " **C. P.**	....	**.30**	**.55**	**2.50**
" " " powd	....	....	**.25**	**.80**
" **Silicate** pure	**.20**	**.50**	**1.50**	.....
" **Sodium Sulphate** powd. tech	....	**.20**	**.35**	**1.50**
" " " **C. P.**	**.20**	**.40**	**1.10**	.....
" **Sulphate** ground tech	....	....	**.20**	**.70**
" " gran. U. S. P	....	**.20**	**.40**	**1.60**
" " cryst. **C. P.**	**.20**	**.35**	**.75**	**3.50**
" **Sulphide**	**.30**	**.85**	**2.50**	.....
" **Sulphite C. P.**	**.25**	**.55**	**1.50**	.....
" **Tartrate C. P.**	**.25**	**.55**	**1.50**	.....
Amalgam Sodium—see Sodium Amalgam	....	....	....	.....
Ammonium Acetate C. P.	**.20**	**.35**	**.90**	.....
" **Arsenate C. P.**	**.40**	**1.20**	**3.50**	.....
" **Arsenite C. P.**	**.35**	**1.00**	**3.00**	.....
" **Benzoate** U. S. P	**.30**	**.70**	**2.00**	.....
" **Bicarbonate** pure	....	**.25**	**.50**	.....
" " **C. P.**	**.20**	**.30**	**.70**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Ammonium Bichromate cryst. tech	....	**$0.30**	**$0.75**	.....
" " " **C. P.**	**$0.20**	**.45**	**1.25**	.....
" **Bifluoride** pure	....	**.50**	**1.25**	.....
" **Binoxalate C. P.**	**.25**	**.55**	**1.60**	.....
" **Biphosphate C. P.**—see Ammonium Phosphate Mono	....	....	....	.....
" **Bisulphate C. P.**	**.20**	**.35**	**.90**	.....
" **Bisulphite** solution **C. P.**	**.25**	**.40**	**.80**	.....
" **Bitartrate C. P.**	**.30**	**.65**	**1.75**	.....
" **Borate C. P.**	**.30**	**.65**	**1.80**	.....
" **Bromide** U. S. P	**.20**	**.35**	**1.00**	.....
" " **C. P.**	**.25**	**.50**	**1.50**	.....
" **Carbonate** lump U. S. P	....	**.25**	**.50**	**$1.75**
" " " **C. P.**	....	**.30**	**.65**	**2.50**
" " powd. U. S. P	....	**.30**	**.55**	**2.25**
" " cubes U. S. P. ½"	....	**.35**	**.75**	.....
" " " **C. P.**	....	**.45**	**1.00**	.....
" **Chloride** lump (Sal Ammoniac)	....	**.25**	**.50**	**2.20**
" " gran. white tech	....	....	**.25**	**1.05**
" " " U. S. P	....	**.20**	**.40**	**1.75**
" " **C. P.**	....	**.30**	**.60**	**2.50**
" **Chromate C. P.**	**.30**	**.70**	**2.00**	.....
" **Citrate C. P.**	**.30**	**.75**	**2.25**	.....
" **Fluoride** cryst. pure	**.30**	**.50**	**1.50**	.....
" " **C. P.**	**.35**	**.85**	**2.60**	.....
" **Formate C. P.**	**.30**	**.70**	**2.00**	.....
" **Hydroxide** 26° Be. tech	....	....	**.45**	4 lb. **1.20**
" " 26° Be. 90 lb. carboy	....	....	....	per lb. **.13**
" " (Carboy extra and returnable **5.00**)	....	....	....	.....
" " Sp. Gr. 0.90 **C. P.**	....	....	**.60**	4 lb. **1.65**
" " Sp. Gr. 0.90 **C. P.** case of 10x4 bots. **9.50**	....	....	....	.....
(Case and Bottles extra and returnable **5.50**)	....	....	....	.....
" " Sp. Gr. 0.90 **C. P.** 90 lbs. carboy	....	....	....	per lb. **.17**
" " (Carboy extra and returnable **5.00**)	....	....	....	.....
" **Hydrosulphide** dark **C. P.**	....	**.35**	**.60**	**2.00**
" " light **C. P.**	....	**.35**	**.60**	**2.00**
" **Iodide** U. S. P	**.75**	**2.35**	....	.....
" **Molybdate C. P.**	**.35**	**.85**	**2.40**	.....
" " HNO_3 solution	....	**.60**	**1.45**	**6.00**
" **Nitrate** cryst. pure	....	**.30**	**.55**	**2.25**
" " " **C. P.**	**.20**	**.35**	**.80**	**3.25**
" **Nitrite** solution	**.25**	**.50**	**1.25**	.....
" **Oxalate** pure	**.20**	**.30**	**.75**	.....
" " **C. P.**	**.25**	**.40**	**1.10**	.....
" **Perchlorate C. P.**	**.20**	**.50**	**1.40**	.....
" **Persulphate C. P.**	**.20**	**.45**	**1.15**	.....
" **Phosphate** tech	....	**.20**	**.45**	**2.00**
" " Primary Monobasic **C. P.** $NH_4H_2PO_4$	**.20**	**.45**	**1.35**	.....
" " Secondary Dibasic **C. P.** $(NH_4)_2HPO_4$	**.20**	**.45**	**1.35**	.....
" **Phosphomolybdate C. P.**	**1.00**	....	....	.....
" **Salicylate** U. S. P	**.25**	**.70**	**2.00**	.....
" **Silicofluoride C. P.**	**.30**	**.75**	**2.35**	.....
" **Sulphate** tech	....	....	**.20**	**.65**
" " white pure	....	**.20**	**.35**	**1.50**
" " **C. P.**	....	**.25**	**.55**	**2.40**
" **Sulphide**—see Ammonium Hydrosulphide	....	....	....	.....
" **Sulphite** cryst. **C. P.**	**.20**	**.45**	**1.20**	.....
" **Sulphocyanide**—see Ammonium Thiocyanate	....	....	....	.....
" **Tartrate Neutral C. P.**	**.25**	**.65**	**1.65**	.....
" **Thiocyanate C. P.**	**.25**	**.50**	**1.40**	.....
" **Valerianate** U. S. P	**.55**	....	....	.....
" **Vanadate C. P.**	**1.10**	....	....	.....
Amygdalin	**3.50**	....	....	.....
Amyl Acetate (Pear Oil Artif.) tech	**.20**	**.40**	**.90**	.....
" " pure	**.20**	**.45**	**1.00**	.....
" **Bromide Iso**	**.75**	....	....	.....
" **Butyrate**	**.35**	**.90**	**2.60**	.....
" **Formate**	**.70**	**2.00**	....	.....
" **Iodide Iso**	**1.40**	....	....	.....
" **Nitrate Iso**	**.85**	....	....	.....
" **Nitrite** U. S. P	**.55**	....	....	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Amyl Salicylate	$0.40	$1.00	....	.....
" **Valerianate**	.55	1.40	....	.....
Amylene pure (Trimethylethylene)	.50	1.35	....	.....
" **Hydrate** (Amyl Alcohol Tertiary)	.50	1.35	....	.....
Amylopsin	.60	1.60	....	.....
Aniline pure	....	.30	$0.60	$2.50
" **C. P.**	.20	.40	.90	4.00
" **Acetate**	.35	1.00	....	.....
" **Dimethyl** tech	.25	.50	1.50	.....
" **Hydrochloride,** tech	....	.30	.90	.....
" " **C. P.**	.25	.50	1.50	.....
" **Sulphate C. P.**	.20	.40	1.25	.....

ANILINE DYES

Black Nigrosine Alc. soluble	.40	1.00	....	.....
" " water soluble	.35	.90	....	.....
" **Oil** soluble	.40	1.10	....	.....
Blue Acid	.45	1.35	....	.....
" **Methylene**	.45	1.35	....	.....
Brown Bismarck	.35	.90	....	.....
Green Malachite	.50	1.40	....	.....
Orange Methyl (Indicator)	.60	1.80	....	.....
Red Alizarine	.60	1.85	....	.....
" **Biebrich Scarlet** pure	1.35	....	....	.....
" **Congo**	.35	.95	....	.....
" **Eosine** yellowish	.45	1.45	....	.....
" **Erythrosine**	.90	....	....	.....
" **Fuchsine**	.45	1.45	....	.....
" **Gallein**	.70	1.90	....	.....
" **Iodeosine**	.80	....	....	.....
" **Safranine**	.45	1.45	....	.....
" **Oil Soluble**	.40	1.10	....	.....
Violet Methyl 3B	.45	1.35	....	.....
Yellow Chrysophenin	.45	1.20	....	.....
" **Fluorescin**	3.35	....	....	.....
" **Naphthol**	.50	1.50	....	.....
" **Primuline**	.40	1.10	....	.....
" **Tartrazine**	.45	1.45	....	.....
" **Uranine**	.50	1.60	....	.....
Anthracene, tech	.20	.40	.95	.....
" Sublimed Purif	.35	.90	2.50	.....
Anthraquinone Resublimed	.45	1.10	3.25	.....
Antimony Metal, lump	....	.25	.45	2.00
" " " **C. P.**	.20	.40	1.00	.....
" " powd	.20	.35	.65	.....
" " sticks	.20	.40	1.00	.....
" **(ic) Chloride Penta, C. P.**	.35	.70	1.70	.....
" **(ous)** " Tri. cryst. **C. P.**	.35	.70	1.70	.....
" **(ous)** " Solution tech. (Butter Antimony)	....	.35	.75	.....
" **(ic) Oxide Penta, C. P.**	.30	.65	1.70	.....
" **(ous) Oxide,** Tri. pure	.20	.35	.65	.....
" " " " **C. P.**	.20	.45	1.15	.....
" **Oxychloride C. P.**	.30	.80	2.25	.....
" **Potassium Tartrate** powd. U. S. P. (Tartar Emetic)	.20	.30	.70	.....
" " " **C. P.**	.25	.60	1.50	.....
" **Sulphate, C. P.**	.30	.75	2.25	.....
" **(ous) Sulphide** Tri. black powd	....	.25	.50	.....
" " " Oxy Red (Kermes Mineral)	.20	.40	.95	.....
" **(ic)** " Penta Golden tech	.20	.40	.95	.....
Arabinose cryst. (Pectin Sugar)	....	....	....	10 Gm. 6.00
Arrowroot—see Starch	....	....	....	.....
Arsenic Metal cryst	.20	.45	1.10	.....
" " powd	.20	.50	1.25	.....
" **(ous)** Bromide	.65	....	....	.....
" " Chloride **C. P.**	.40	.95	2.25	.....
" " Iodide U. S. P	.95	....	....	.....
" **(ic) Oxide**—see Acid Arsenic	....	....	....	.....
" **Trioxide**—see Acid Arsenous	....	....	....	.....
" **(ic) Sulphide** red powd	.20	.30	.75	.....
" **(ous)** " yellow powd	.20	.30	.75	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Asbestos short fibre	....	....	**$0.25**	**$0.80**
" medium " acid washed for Gooch Filter	**$0.45**	**$1.35**	**4.00**	.....
" " " " " and ignited	**.50**	**1.50**	**4.50**	.....
" long fibre unwashed	**.25**	**.55**	**1.50**	.....
" " " acid washed	**.60**	**1.65**	**5.00**	.....
" " " " " and ignited	**.65**	**1.75**	**5.25**	.....
" platinized 5%	**12.00**	....	....	¼ oz. **3.60**
Asparagin pure	....	....	....	25 Gm. **3.50**
Asphaltum lump	....	**.20**	**.35**	**1.50**
" varnish	....	**.30**	**.60**	.....
Baking Powder (set of 4 cans **.70**)	....	....	....	.....
Balsam Fir Canada filtered natural	**.45**	**1.15**	**3.35**	.....
" " " " dry	**.65**	**1.95**	**5.75**	.....
" " " " in Xylol	**.60**	**1.65**	**4.75**	.....
Barium Acetate C. P.	**.20**	**.45**	**1.25**	.....
" **Bichromate C. P.**	**.30**	**.65**	**2.00**	.....
" **Bromate C. P.**	**.50**	**1.35**	**4.00**	.....
" **Bromide C. P.**	**.40**	**1.15**	**3.25**	.....
" **Carbonate** tech	....	**.20**	**.30**	**1.25**
" " pure	....	**.25**	**.55**	**2.50**
" " **C. P.**	**.20**	**.40**	**1.00**	.....
" **Chlorate** powd. tech	**.20**	**.30**	**.65**	.....
" " cryst. **C. P.**	**.25**	**.45**	**1.30**	.....
" **Chloride** cryst. tech	....	....	**.20**	**.80**
" " " **C. P.**	....	**.30**	**.60**	**2.50**
" " anhyd. **C. P.**	**.20**	**.40**	**1.20**	.....
" **Chromate C. P.**	**.25**	**.70**	**2.00**	.....
" **Citrate** cryst. **C. P.**	**.70**	**1.95**	....	.....
" **Dioxide** tech	....	**.30**	**.60**	**2.50**
" " **C. P.**	**.25**	**.40**	**.85**	.....
" " anhyd. **C. P.**	**.25**	**.45**	**1.05**	.....
" **Fluoride C. P.**	**.30**	**.55**	**1.60**	.....
" **Hydroxide** cryst. tech	....	**.20**	**.40**	**1.50**
" " " **C. P.**	**.20**	**.30**	**.65**	**2.75**
" " anhyd. **C. P.**	**.25**	**.45**	**1.30**	.....
" **Iodide**	**.85**	....	....	.....
" **Nitrate** powd. tech	....	**.20**	**.40**	**1.35**
" " cryst. **C. P.**	**.20**	**.40**	**.85**	**3.75**
" **Oxalate C. P.**	**.30**	**.50**	**1.50**	.....
" **Oxide** (mono) anhyd. **C. P.**	**.25**	**.50**	**1.45**	.....
" **Peroxide**—see Barium Dioxide	....	....	....	.....
" **Phosphate C. P.**	**.35**	**.90**	**2.60**	.....
" **Silicofluoride**	**.30**	**.75**	**2.25**	.....
" **Sulphate** tech	....	....	**.25**	**.80**
" " **C. P.**	**.20**	**.45**	**1.00**	.....
" **Sulphide** powd. black tech	....	**.20**	**.40**	**1.75**
" " " yellow pure	**.20**	**.30**	**.70**	.....
" " **C. P.**	**.25**	**.65**	**1.75**	.....
" **Sulphite C. P.**	**.25**	**.65**	**1.90**	.....
" **Tartrate C. P.**	**.45**	**1.30**	**3.90**	.....
" **Thiocyanate C. P.**	**.35**	**.90**	**2.50**	.....
Beef Extract Liebig	....	**1.35**	**3.65**	2 oz. **.75**
" " Bacto	....	**1.50**	**4.70**	2 oz. **.85**
Beeswax—see Wax Bees white and yellow	....	....	....	.....
Benzaldehyde (Oil Bitter Almonds artif.) U. S. P	**.35**	**.90**	**2.75**	.....
Benzene (Benzol) 90% white, 1 pt. **.40** 1 qt. **.60**	....	**.25**	....	1 Gal. **1.25**
" " **C. P.** crystallizable (Thiophene free)	....	**.35**	**.65**	**2.75**
" **Monobromo**—see Monobromo Benzene	....	....	....	.....
" **Monochloro**—see Monochloro Benzene	....	....	....	.....
Benzidine base tech	**.30**	**.80**	**2.50**	.....
" " for blood test **C. P.**	**1.35**	....	....	.....
" **Sulphate C. P.**	**1.50**	**4.50**	....	.....
Benzine (Petroleum) 1 pt. **.35** 1 qt. **.60**	....	....	....	1 Gal. **.90**
Benzole—see Benzene	....	....	....	.....
Benzoyl Chloride C. P.	**.45**	**1.00**	**3.00**	.....
Benzyl Acetate	**.65**	**1.65**	**4.75**	.....
" **Alcohol**—see Alcohol Benzyl	....	....	....	.....
" **Chloride**	**.30**	**.60**	**1.60**	.....
Beryllium Carbonate C. P.	**2.75**	....	....	.....
" **Nitrate** cryst. **C. P.**	**1.20**	....	....	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Beryllium Oxide	**$4.80**	....	....	.....
" **Sulphate**	**2.75**	....	....	.....
Betanaphthol—see Naphthol Beta	....	....	....	.....
Betanaphthylamine—see Naphthylamine Beta	....	....	....	.....
Bismuth Metal lump	**.40**	**$1.15**	**$3.25**	.....
" " **C. P.**	**.45**	**1.35**	**4.00**	.....
" **Acetate C. P.**	**.70**	**2.00**	....	.....
" **Carbonate** U. S. P	**.45**	**1.20**	....	.....
" **Chloride** Tri. **C. P.**	**.60**	**1.60**	**5.00**	.....
" **Hydroxide C. P.**	**.55**	**1.60**	....	.....
" **Nitrate** cryst. **C. P.**	**.45**	**1.15**	**3.20**	.....
" " basic—see Bismuth Subnitrate	....	....	....	.....
" **Oxide** Tri. **C. P.**	**.60**	**1.75**	....	.....
" " **Tetra C. P.**	**.85**	**2.55**	....	.....
" **Oxychloride** pure	**.50**	**1.50**	....	.....
" **Phosphate**	**.55**	**1.65**	....	.....
" **Salicylate** basic U. S. P	**.40**	**1.00**	....	.....
" **Subnitrate** U. S. P	**.35**	**.90**	**2.50**	.....
" **Sulphate**	**.60**	**1.65**	....	.....
Bleaching Powder—see Calcium Hypochlorite	....	....	....	.....
Bone Ash—see Calcium Phosphate Tribasic	....	....	....	.....
" **Charcoal** / " **Black** —see Charcoal Animal	....	....	....	.....
Borax—see Sodium Borate	....	....	....	.....
" glass	....	**.25**	**.60**	.....
Brimstone—see Sulphur Roll	....	....	....	.....
Bromine N. F.	**.55**	**.85**	**1.75**	.....
" **C. P.**	**.60**	**.95**	**2.00**	.....
" water	....	**.30**	**.50**	**$2.00**
Brucine Alkaloid pure cryst	**.50**	....	....	.....
" **Sulphate** " "	**.50**	....	....	.....
Burnt Sugar—see Caramel	....	....	....	.....
Butter Antimony—see Antimony Chloride Solution	....	....	....	.....
" **Cocoa**—see Cocoa Butter	....	....	....	.....
Butyl Acetate	**.20**	**.35**	**1.00**	.....
" **Alcohol**—see Alcohol Butyl	....	....	....	.....
Cadmium Metal mossy	**.25**	**.70**	**2.20**	.....
" " sticks	**.25**	**.65**	**2.00**	.....
" **Acetate C. P.**	**.40**	**1.15**	**3.25**	.....
" **Bromide C. P.**	**.40**	**1.00**	**3.00**	.....
" **Carbonate C. P.**	**.35**	**.90**	**2.80**	.....
" **Chloride** cryst. **C. P.**	**.30**	**.75**	**2.25**	.....
" " anhyd. **C. P.**	**.35**	**.90**	**2.75**	.....
" **Hydroxide C. P.**	**.50**	**1.35**	**4.00**	.....
" **Iodide C. P.**	**.75**	**2.15**	....	.....
" **Nitrate C. P.**	**.30**	**.65**	**1.75**	.....
" **Oxalate C. P.**	**.55**	**1.70**	**5.60**	.....
" **Oxide C. P.**	**.55**	**1.50**	**4.50**	.....
" **Sulphate C. P.**	**.35**	**.85**	**2.50**	.....
" **Sulphide** Orange	**.40**	**1.15**	**3.25**	.....
" **Sulphite C. P.**	**.60**	**1.65**	**5.00**	.....
Caffeine Alkaloid U. S. P	**.45**	**1.50**	....	.....
Calcium Metal electrolytic	**.65**	**2.00**	**6.00**	.....
" **Acetate** tech	....	**.25**	**.45**	**2.00**
" " **C. P.**	**.20**	**.45**	**1.40**	.....
" **Arsenate C. P.**	**.35**	**1.00**	**3.00**	.....
" **Arsenite C. P.**	**.35**	**1.05**	**3.15**	.....
" **Benzoate** pure	**.30**	**.80**	**2.50**	.....
" **Bichromate** cryst. **C. P.**	**.50**	**1.50**	....	.....
" **Biphosphate**—see Calcium Phosphate Monobasic	....	....	....	.....
" **Borate C. P.**	**.25**	**.70**	**2.00**	.....
" **Bromide** U. S. P	**.25**	**.45**	**1.35**	.....
" **Carbide** lump	....	....	**.30**	**1.10**
" **Carbonate** (Natural Chalk) lump	....	....	**.25**	**.90**
" " Marble chips (pea size)	....	....	**.20**	**.45**
" " " dust	....	....	**.20**	**.55**
" " Precip. pure	....	....	**.25**	**.75**
" " " **C. P.**	**.20**	**.40**	**1.05**	.....
" " (Iceland Spar) for standardizing	**.45**	**1.25**	**3.75**	.....
" **Chlorate C. P.**	**.40**	**1.20**	**3.50**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Calcium Chloride calcined porous gran. 8 mesh pure	....	**$0.30**	**$0.60**	**$2.30**
" " " " " " " " **C. P.**	....	**.40**	**.80**	**3.50**
" " cryst. **C. P.**	....	**.30**	**.75**	**3.15**
" " fused lump for desiccator pure	....	**.25**	**.50**	**2.10**
" " sticks **C. P.**	**$0.20**	**.55**	**1.65**	.....
" **Chromate C. P.**	**.35**	**1.10**	**3.20**	.....
" **Citrate** pure	**.25**	**.55**	**1.60**	.....
" **Cyanamide** tech	....	....	**.35**	**1.50**
" **Fluoride** tech	....	....	**.20**	**.65**
" " **C. P.**	**.20**	**.55**	**1.65**	.....
" **Formate C. P.**	**.25**	**.60**	**1.70**	.....
" **Hydroxide** tech	....	....	**.20**	**.60**
" " pure, from marble	....	**.25**	**.50**	**2.00**
" **Hypochlorite** tech 12 oz. can **$0.20**	....	....	....	**.80**
" **Iodide**	**.75**	**2.40**	....	.....
" **Nitrate C. P.**	**.20**	**.40**	**1.05**	.....
" **Oxalate** pure	**.25**	**.50**	**1.50**	.....
" **Oxide** tech. in tin	....	....	**.20**	**.50**
" " pure, from marble	....	**.20**	**.45**	**1.75**
" " **C. P.**	....	**.35**	**1.00**	.....
" **Peroxide**	**.45**	**1.15**	**3.40**	.....
" **Phosphate Monobasic** crude	....	....	**.20**	**.60**
" " " **C. P.** $Ca(H_2PO_4)_2+H_2O$	**.25**	**.50**	**1.40**	.....
" " **Dibasic**	....	**.25**	**.55**	**2.10**
" " " **C. P.** $CaHPO_4+2H_2O$	**.20**	**.45**	**1.30**	.....
" " **Tribasic** ppt. tech. Bone Ash	....	**.20**	**.35**	**1.40**
" " " **C. P.** $Ca_3(PO_4)2$	**.25**	**.50**	**1.50**	.....
" **Phosphide** gran	**.45**	**1.00**	**3.00**	.....
" **Salicylate**	**.25**	**.70**	**2.10**	.....
" **Silicate** pure	**.25**	**.50**	**1.50**	.....
" **Silico Fluoride C. P.**	**.30**	**.80**	**2.40**	.....
" **Sulphate** native lump (Gypsum)	....	....	**.20**	**.50**
" " " powd. (Gypsum)	....	....	**.20**	**.50**
" " calcined (Plaster Paris)	....	....	**.20**	**.50**
" " **C. P.**	....	**.35**	**.75**	**3.25**
" **Sulphide** U. S. P	....	**.30**	**.70**	.....
" " phosphorescent	**.30**	**.75**	**2.25**	.....
" **Sulphite** Precip	....	**.25**	**.55**	.....
" " **C. P.**	**.35**	**.85**	**1.90**	.....
" **Tartrate C. P.**	**.35**	**.80**	**2.00**	.....
" **Tungstate** Precip	**.65**	....	....	.....
Calomel—see Mercury (ous) Chloride	....	....	....	.....
Camphor—see Gum Camphor	....	....	....	.....
Canada Balsam—see Balsam fir, Canada	....	....	....	.....
Caoutchouc—see Rubber Crude	....	....	....	.....
Caramel (Sugar Color) Burnt Sugar	.....	**.25**	**.55**	.....
Carbon Disulphide tech 10 lb. **2.35**	....	**.25**	**.45**	**1.40**
" " **C. P.**	....	**.30**	**.55**	**2.30**
NOTE: Carbon Disulphide can be shipped only by freight. Express or Parcel Post shipments are prohibited by law.				
" **Granular**	....	....	**.35**	**1.50**
" **Tetrachloride** tech 10 lb. **2.40**	....	**.25**	**.45**	**1.45**
" " **C. P.**	....	**.30**	**.70**	**3.00**
Carborundum cryst	**.20**	**.45**	**1.20**	.....
" powd	**.20**	**.30**	**.80**	.....
Carmine No. 40	**.85**	**2.75**	....	.....
Casein from Milk	....	**.25**	**.60**	.....
Celloidin Shreds—see Pyroxylin	....	....	....	.....
Cellulose Acetate	**.50**	**1.50**	**4.50**	.....
" **Nitrate** (Gun Cotton)	**.45**	**1.35**	**4.00**	.....
Ceresin Black (Ozokerite)	....	**.30**	**.65**	.....
" White	....	**.30**	**.60**	.....
" Yellow	....	**.30**	**.60**	.....
Cerium Chloride C. P.	**1.00**	**3.00**	**9.00**	.....
" **Nitrate C. P.**	**.55**	**1.60**	**4.75**	.....
" **Oxalate** U. S. P	**.20**	**.30**	**.80**	.....
" **Oxide C. P.**	**1.00**	**3.00**	**9.00**	.....
" **(ic) Sulphate**	**1.00**	**3.00**	**9.00**	.....
Chalk, Native Lump, " " powdered, " Precip. —see Calcium Carbonate	....	....	....	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Charcoal Animal Gran	....	....	**$0.25**	**$1.00**
" " powd	....	....	**.25**	**1.00**
" " Purif. Moist	**$0.20**	**$0.35**	**1.10**	.....
" **Blood** Acid Washed **C. P.**	**.40**	**1.20**	**3.60**	.....
" **Decolorizing** for Filtering	....	**.25**	**.50**	**2.00**
" **Sponge**	**.60**	**1.80**	....	.....
" **Sugar C. P.**	**.60**	**1.80**	....	.....
" **Wood** lump	....	....	**.25**	**.60**
" " powder	....	....	**.20**	**.50**
" " sticks Doz. **.80**	....	....	....	.....
Chloral Hydrate cryst. U. S. P	**.25**	**.50**	**1.50**	.....
Chloretone	**1.50**	....	....	.....
Chlorinated Lime—see Calc. Hypochlorite	....	....	....	.....
Chlorine Water	....	**.30**	**.60**	**2.25**
Chloroform tech	....	**.30**	**.60**	**2.75**
" U. S. P	....	**.35**	**.75**	**3.15**
" **C. P.**	....	**.40**	**1.00**	.....
Chlorophyll Fat and Oil Soluble	**.45**	**1.25**	**3.70**	.....
" Alcohol Soluble	**.70**	**2.00**	**5.90**	.....
" Water Soluble	**.55**	**1.50**	**4.40**	.....
Cholesterin	....	....	....	10 Gm. **2.00**
Chrome Alum—see Chromium Potassium Sulphate	....	....	....	.....
Chromium Metal pure fused	**.30**	**.75**	**2.25**	.....
" **Acetate** Basic **C. P.**	**.40**	**1.15**	**3.35**	.....
" **Borate C. P.**	**.45**	**1.25**	**3.70**	.....
" **Bromide C. P.**	**.85**	....	....	.....
" **Carbonate** Basic **C. P.**	**.35**	**.90**	**2.65**	.....
" **(ic) Chloride** dry **C. P.**	**.30**	**.70**	**2.00**	.....
" **Fluoride C. P.**	**.55**	**1.50**	**4.50**	.....
" **Hydroxide** tech	**.20**	**.30**	**.80**	.....
" " **C. P.**	**.40**	**1.10**	**3.15**	.....
" **Nitrate** dry **C. P.**	**.30**	**.65**	**1.75**	.....
" **Oxalate C. P.**	**.30**	**.75**	**2.15**	.....
" **Oxide Sesqui** Anhyd. pure	**.20**	**.45**	**1.25**	.....
" " " **C. P.**	**.30**	**.80**	**2.40**	.....
" " Tri—see Acid Chromic	....	....	....	.....
" **Phosphate C. P.**	**.40**	**1.20**	**3.50**	.....
" **Potassium Sulphate** (Chrome Alum) pure	....	**.20**	**.30**	**1.25**
" " " " " **C. P.**	**.20**	**.35**	**1.00**	.....
" **Sulphate** pure dry	**.25**	**.40**	**1.10**	.....
" " **C. P.**	**.30**	**.55**	**1.50**	.....
Cinnabar Artificial powd.—see Mercury Sulphide red	....	....	....	.....
Clay China—see Kaolin	....	....	....	.....
Cobalt Metal 98-99% cubes	**.60**	**1.80**	**5.40**	.....
" " " " gran	**.70**	**2.15**	**6.50**	.....
" **Acetate C. P.**	**.40**	**1.10**	**3.20**	.....
" **Ammonium Sulphate C. P.**	**.35**	**.85**	**2.50**	.....
" **Arsenate C. P.**	**1.00**	....	....	.....
" **Carbonate C. P.**	**.75**	**2.20**	**6.50**	.....
" **Chloride** cryst. **C. P.**	**.40**	**1.00**	**2.90**	.....
" **Chromate C. P.**	**.75**	**2.20**	**6.50**	.....
" **Hydroxide C. P.**	**.75**	**2.20**	**6.50**	.....
" **Nitrate** cryst. **C. P.**	**.40**	**1.00**	**2.90**	.....
" **Nitrite C. P.**	**.60**	**1.75**	**5.25**	.....
" **Oxalate C. P.**	**.65**	**1.90**	**5.60**	.....
" **(ic) Oxide** Black **C. P.**	**.55**	**1.60**	**4.80**	.....
" **Phosphate C. P.**	**1.25**	**4.40**	....	.....
" **Sodium Nitrite C. P.**—see Sodium Cobaltic Nitrite	....	....	....	.....
" **Sulphate C. P.** cryst	**.35**	**.90**	**2.70**	.....
Cocoa Butter	....	**.45**	**1.20**	.....
Cochineal whole	**.25**	**.75**	**2.25**	.....
" powd	**.30**	**.80**	**2.40**	.....
Collodion U. S. P	....	**.30**	**.70**	.....
" Flexible	....	**.35**	**.80**	.....
" **C. P.**	....	**.40**	**1.10**	.....
Copper Metal Foil No. 36 B & S	**.20**	**.40**	**.80**	.....
" " **Gran.** pure	**.20**	**.45**	**.85**	.....
" " **Powder** precip	**.30**	**.75**	**2.20**	.....
" " **Rivets** ½ inch	....	**.30**	**.70**	.....
" " **Sheet** 1/32 inch	....	**.40**	**.75**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Copper Metal Gran. 1/64 inch	....	**$0.45**	**$0.85**	.....
" " **Shot**—(Punchings)	....	**.25**	**.60**	**$2.50**
" " **Turnings**	....	**.25**	**.50**	**2.00**
" " **Wire** bare No. 10	....	....	**.60**	.....
" " " " No. 12	....	....	**.60**	.....
" " " " No. 14	....	....	**.60**	.....
" " " " No. 16	....	**.30**	**.65**	.....
" " " " No. 18	....	**.35**	**.75**	.....
" " " " No. 24	....	**.45**	**.95**	.....
" " " " No. 30	....	**.55**	**1.40**	.....
" **Acetate** Basic powd	....	**.35**	**.85**	.....
" **(ic) Acetate Neutral** cryst. **C. P.**	**$0.25**	**.50**	**1.50**	.....
" **Acetoarsenite**—Paris Green	....	**.30**	**.60**	.....
" **(ic) Ammonium Chloride C. P.**	**.20**	**.40**	**1.20**	.....
" " " **Sulphate C. P.** cryst	**.20**	**.35**	**1.00**	.....
" " **Arsenate C. P.**	**.35**	**.90**	**2.75**	.....
" " **Arsenite C. P.**	**.35**	**.90**	**2.75**	.....
" **Bichloride**—see Copper (ic) Chloride	....	....	....	.....
" **(ic) Borate C. P.**	**.50**	**1.45**	**4.25**	.....
" " **Bromide C. P.**	**.35**	**.95**	**2.75**	.....
" **(ous)** " **C. P.**	**.40**	**1.05**	**3.10**	.....
" **(ic) Carbonate Green** tech	....	**.25**	**.60**	**2.50**
" " " " **C. P.**	**.30**	**.60**	**1.80**	.....
" " **Chloride** cryst. pure	....	**.30**	**.70**	.....
" " " " **C. P.**	**.20**	**.35**	**1.00**	.....
" " " Anhyd. **C. P.**	**.25**	**.45**	**1.40**	.....
" **(ous)** " **C. P.**	**.25**	**.50**	**1.50**	.....
" **(ic) Chromate C. P.**	**.30**	**.60**	**1.80**	.....
" " **Citrate** pure	**.35**	**.70**	**2.00**	.....
" **(ous) Cyanide** pure	**.25**	**.45**	**1.40**	.....
" **(ic) Ferrocyanide C. P.**	**.35**	**.85**	**2.50**	.....
" " **Fluoride C. P.**	**.30**	**.70**	**2.00**	.....
" " **Formate**	**.35**	**.90**	**2.70**	.....
" " **Hydroxide C. P.**	**.35**	**.95**	**2.75**	.....
" **(ous) Iodide**	**.80**	....	....	.....
" **(ic) Nitrate** cryst. tech	....	**.30**	**.75**	**3.50**
" " " " **C. P.**	**.20**	**.40**	**1.10**	.....
" " **Oleate**	....	**.35**	**1.00**	.....
" " **Oxalate C. P.**	**.35**	**.95**	**2.80**	.....
" " **Oxide** powd. black tech	....	**.25**	**.60**	**2.75**
" " " " **C. P.**	**.30**	**.65**	**1.75**	.....
" " gran. pure	**.25**	**.55**	**1.60**	.....
" " wire **C. P.**	**.30**	**.60**	**1.70**	.....
" **(ous)** " powd. red tech	**.20**	**.30**	**.75**	.....
" " " **C. P.**	**.20**	**.45**	**1.25**	.....
" **(ic) Phosphate C. P.**	**.35**	**.90**	**2.70**	.....
" " **Potassium Chloride C. P.**	**.20**	**.40**	**1.10**	.....
" " " **Sulphate C. P.**	**.20**	**.40**	**1.20**	.....
" " **Sulphate** cryst. tech	....	....	**.25**	**.90**
" " " powd. "	....	....	**.30**	**1.25**
" " " cryst. U. S. P.	....	**.20**	**.40**	**1.55**
" " " " **C. P.**	....	**.30**	**.60**	**2.50**
" " " Anhyd. pure	**.20**	**.35**	**.95**	.....
" " " " **C. P.**	**.25**	**.40**	**1.20**	.....
" " **Sulphide C. P.**	**.20**	**.50**	**1.50**	.....
" **(ous) Sulphide C. P.**	**.20**	**.50**	**1.50**	.....
" **(ic) Tartrate** pure	**.30**	**.80**	**2.30**	.....
" **(ous) Thiocyanate C. P.**	**.45**	**1.30**	**3.80**	.....
Copperas—see Iron (ous) Sulphate	....	....	....	.....
Corallin (indicator)—see Acid Rosolic	....	....	....	.....
Cork Powder	....	**.25**	**.60**	.....
Corrosive Sublimate—see Mercury (ic) Chloride	....	....	....	.....
Cotton Absorbent	**.20**	**.40**	**.90**	.....
" **Soluble**—see Cellulose Nitrate	....	....	....	.....
" **Non-Absorbent**	....	....	**.80**	.....
Cream of Tartar—see Potassium Bitartrate	....	....	....	.....
Creatin	....	....	....	10 Gm. **2.70**
Creatinine	....	....	....	10 Gm. **3.50**
" **Zinc Chloride**	....	....	....	10 Gm. **3.50**

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Creosote from Coal Tar	....	**$0.25**	**$0.60**	.....
" " Wood Tar U. S. P.	....	**.35**	**1.00**	.....
Cresol U. S. P.	....	**.25**	**.65**	.....
" **Meta**	**$0.40**	**1.00**	**3.00**	.....
" **Ortho**	**.20**	**.40**	**1.10**	.....
" **Para**	**.40**	**1.00**	**3.00**	.....
Crocus Martis—see Iron (ic) Oxide red	....	....	....	.....
Damar Gum—see Gum Damar	....	....	....	.....
Decalso (Water Softener)	....	**.35**	**1.00**	.....
Devarda's Alloy for reduction	**.30**	**.80**	**2.40**	.....
Developer, Photographic, in tubes, each **.12**	....	....	....	.....
Dextrine Corn Yellow	....	....	**.25**	**$1.00**
" " White	....	....	**.25**	**1.00**
" **C. P.**	**.30**	**.75**	**2.25**	.....
Dextrose Syrup	....	**.20**	**.30**	**1.00**
" Lump	....	....	**.20**	**.75**
" Gran. pure	....	....	**.25**	**.95**
" Powd. pure	**.20**	**.35**	**.90**	.....
" " Anhyd. **C. P.**	**.25**	**.50**	**1.50**	.....
" " " Bacto	....	**1.50**	**5.00**	½ lb. **2.75**
Diastase of Malt powder	**.45**	**1.25**	**3.75**	.....
" " " liquid	**.25**	**.50**	**1.50**	.....
" **Taka**—Taka Diastase	**2.75**	....	....	½ oz. **1.65**
" " liquid	**.40**	**1.15**	**3.25**	.....
Dichloricide for killing insects	....	**.25**	**.60**	**2.55**
Diethyl Sulphate (Ethyl Sulphate)	**.30**	**.75**	**2.15**	.....
Dimethyl Sulphate (Methyl Sulphate)	**.25**	**.55**	**1.60**	.....
Dimethylamine 25% Sol	**.50**	**1.50**	....	.....
" **Hydrochloride**	**2.75**	....	....	.....
Dimethylaminobenzaldehyde, Para	....	....	....	10 Gm. **1.75** 25 Gm. **3.70**
Dimethylaniline tech	**.25**	**.50**	**1.50**	.....
Dimethylglyoxime C. P.	**1.15**	**4.20**	....	.....
Dinitrobenzene Meta tech	**.20**	**.35**	**1.10**	.....
Dinitrophenol tech	**.20**	**.50**	**1.50**	.....
Diphenylamine tech	**.25**	**.60**	**1.75**	.....
Distilled Water—see Water Distilled	....	....	....	.....
Dulcite (Melampyrite)	....	....	....	10 Gm. **7.30**
" **Iso**—see Rhamnose	....	....	....	.....
Emery powd. medium	....	....	**.30**	**1.00**
" " coarse	....	....	**.30**	**1.00**
" " fine	....	....	**.30**	**1.00**
Eosine bluish	**.45**	**1.45**	....	.....
Epsom Salt—see Magnesium Sulphate	....	....	....	.....
Eschkas Mixture—see Magnesium Oxide and Sodium Carbonate	....	....	....	.....
Ether Petrolic B. P. 20°-40°	....	....	**1.05**	**4.50**
" " B. P. 30°-60°	....	....	**.75**	**3.25**
" **Sulphuric** U. S. P.	....	**.30**	**.60**	**2.50**
" " Anhyd. Dist. over Sodium	....	**.35**	**1.00**	**4.50**
Ethyl Acetate U. S. P.	....	**.30**	**.60**	**2.50**
" " absolute **C. P.**	....	**.35**	**.85**	**3.50**
" **Acetoacetate**	**.35**	**1.00**	**3.00**	.....
" **Benzoate**	**.35**	**.90**	**2.80**	.....
" **Bromide C. P.**	**.30**	**.70**	**2.10**	.....
" **Butyrate Conc.**	**.30**	**.75**	**2.25**	.....
" **Chloride** U. S. P.	**.35**	**.85**	**2.50**	.....
" " in tubes (Kelene)	....	....	....	30 Gm. **1.40**
" " " " "	....	....	....	60 Gm. **1.75**
" **Formate Conc.**	**.30**	**.60**	**1.80**	.....
" **Iodide**	**1.05**	**3.25**	**10.00**	.....
" **Nitrite Conc.**	**.30**	**.55**	**1.60**	.....
" **Salicylate**	**.30**	**.75**	**2.20**	.....
" **Sulphate**—see Diethyl Sulphate	....	....	....	.....
" **Valerianate**	**.50**	**1.40**	....	.....
Ethylene Bromide (Dibromethane)	**.35**	**.90**	**2.60**	.....
" **Chloride** (Dichlorethane)	**.25**	**.50**	**1.50**	.....
Eucalyptol U. S. P.	**.30**	**.65**	**1.90**	.....
Fehling's Solution A	**.20**	**.30**	**.60**	**2.50**
" " B	**.20**	**.35**	**.85**	**3.50**
" " **Tablets**	....	....	....	per set **.90**

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Fibrin from blood	**$0.95**	**$3.00**	....	.....
Fire Clay	....	....	**$0.25**	**$0.90**
Fluorescein, Sodium Salt	**.95**	**2.85**	**8.50**	.....
Fluorescin	**3.35**	....	....	.....
Fluorspar powd.—see Calcium Fluoride	....	....	....	.....
Formaldehyde U. S. P. 40% 1 gal., **$2.00**	....	**.25**	**.40**	**1.40**
" **C. P.**	....	**.30**	**.65**	**2.85**
" **Para** (Trioxymethylene)	....	**.35**	**1.10**	.....
Fructose / **Fruit Sugar** } see Levulose	....	....	....	.....
Fuller's Earth powder	....	....	**.20**	**.75**
Furfurol (Pyromucic Aldehyde)	**.25**	**.50**	**1.50**	.....
Fusel Oil—see Alcohol Amyl	....	....	....	.....
Galatose (Lactoglucose) pure	**1.05**	....	....	.....
Gallnuts—see Nutgall	....	....	....	.....
Gelatine White Silver Label sheet	**.20**	**.45**	**1.30**	.....
" " gran	**.20**	**.45**	**1.40**	.....
" **Gran. Bacto**	....	....	**3.50**	.....
" **Nutrient Bacto**	....	**2.00**	**6.00**	.....
Glass powd	....	....	**.30**	**1.25**
" **Wool** fine	**.30**	**.70**	**2.00**	.....
Glaubers Salt—see Sodium Sulphate	....	....	....	.....
Glucose—see Dextrose	....	....	....	.....
Glue brown	....	**.30**	**.60**	.....
" white flake	....	**.30**	**.60**	.....
" " ground	....	**.30**	**.60**	.....
Gluten Flour	**.20**	**.35**	**1.00**	.....
Glycerine C. P. 1 gal., **4.00**	....	**.25**	**.55**	**2.25**
Glycogen pure	....	....	....	10 Gm. **4.00**
Gold Metal pure foil	....	....	....	1 Gm. **1.45**
" **Leaf pure**—see Section D	....	....	....	.....
" **Bromide** Mono pure	....	....	....	1 Gm. **1.55**
" **Chloride** Tri	....	....	....	1 Gm. **1.00**
" **Sodium Chloride** U. S. P	....	....	....	1 Gm. **.75**
Grape Sugar—see Dextrose	....	....	....	.....
Graphite powder	....	....	**.30**	**1.25**
" flaky	....	**.30**	**.70**	.....
Gum Arabic select tears	**.20**	**.35**	**.75**	.....
" " powd	**.20**	**.35**	**.80**	.....
" **Asphaltum**	....	**.20**	**.35**	**1.50**
" **Benzoin Sumatra**	**.20**	**.45**	**1.35**	.....
" **Camphor**	**.25**	**.65**	**1.85**	.....
" **Catechu**	....	**.25**	**.50**	.....
" **Damar**	**.20**	**.45**	**1.20**	.....
" **Gamboge** select	**.25**	**.65**	**1.75**	.....
" **Guaiac**	**.20**	**.35**	**1.00**	.....
" **Mastic** tears	**.20**	**.45**	**1.25**	.....
" **Sandarac**	**.20**	**.35**	**1.00**	.....
" **Shellac** white	**.25**	**.50**	**1.40**	.....
" " orange	**.25**	**.45**	**1.30**	.....
" **Tragacanth** flake	**.35**	**.95**	**2.75**	.....
" " white powd	**.35**	**.85**	**2.50**	.....
Gypsum native powd. / " calcined } see Calcium Sulphate	....	....	....	.....
Hematoxylin pure cryst	....	....	....	10 Gm. **2.75**
Hemoglobin powd	**.30**	**.80**	**2.30**	.....
" scales	**.35**	**.95**	**2.75**	.....
Hydrogen Peroxide 3% U. S. P	....	**.20**	**.30**	**1.25**
" " 3% **C. P.**	....	....	**.45**	**2.00**
" " 30% = 100 Vol. (Superoxol)	**.60**	**1.15**	**3.30**	.....
" **Sulphide Solution**	....	....	**.65**	**2.50**
Hydrone for generating hydrogen	....	....	**1.75**	2 lb. **2.50**
Hydroquinone	**.30**	**.75**	**2.25**	.....
Hydroxylamine Hydrochloride C. P.	**1.20**	**3.60**	....	.....
Iceland Spar for standardizing—see Calcium Carbonate	....	....	....	.....
Indigo powd	**.30**	**.85**	**2.50**	.....
" **Carmine** paste	....	**.45**	**1.20**	.....
" " dry (soluble in water)	**.35**	**.90**	**2.70**	.....
Infusorial Earth com'l	....	....	**.30**	**1.15**
Inulin	**.75**	**2.25**	....	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Invert Sugar—see Sugar Inverted	....	....	....	.....
Iodine resublimed U. S. P	**$0.75**	**$2.20**	**$7.25**	.....
" " **C. P.**	**.85**	**2.50**	**7.75**	.....
" **Chloride** Tri	**3.00**	**10.50**	....	.....
" **Pentoxide Anhyd.**—see Acid Iodic anhyd	....	....	....	.....
" **Solution** in Potassium Iodide	**.20**	**.35**	**1.00**	.....
" **Tincture** U. S. P	**.25**	**.55**	**1.50**	.....
Iron filings fine	....	....	**.20**	**$0.65**
" " coarse	....	....	**.20**	**.60**
" **Powder**	....	**.25**	**.50**	**1.50**
" " reduced by Hydrogen 90% gray	**.25**	**.55**	**1.55**	.....
" **Wire** No. 16	....	....	**.30**	.....
" " No. 25	....	....	**.35**	.....
" " Picture No. 1 ..... 25 yds., **$0.25**	....	....	....	.....
" " for standardizing	**.45**	**.90**	....	.....
" (ic) **Acetate** basic scales dry pure	**.30**	**.70**	**1.95**	.....
" " " Sol. **C. P.**	**.25**	**.55**	**1.55**	.....
" " **Ammonium Chloride C. P.**	**.25**	**.55**	**1.60**	.....
" " " **Citrate** brown pearls U. S. P	**.25**	**.45**	**1.35**	.....
" " " " green " "	**.25**	**.45**	**1.30**	.....
" " " **Oxalate C. P.**	**.25**	**.50**	**1.50**	.....
" " " **Sulphate C. P.**	....	**.30**	**.60**	**2.50**
" (ous) " " " **C. P.**	....	**.30**	**.60**	**2.50**
" (ic) **Arsenate C. P.**	**.25**	**.55**	**1.65**	.....
" " **Arsenite** pure	**.30**	**.60**	**1.75**	.....
" " **Benzoate** pure	**.45**	**1.30**	....	.....
" (ous) **Bromide**	**.30**	**.70**	**2.00**	.....
" (ic) **Chloride** lumps U. S. P	....	**.25**	**.50**	**1.75**
" " " lumps **C. P.**	....	**.30**	**.60**	**2.35**
" " " anhyd. sublimed **C. P.**	**.35**	**.75**	**2.25**	.....
" (ous) " pure	**.20**	**.35**	**.90**	.....
" " " **C. P.**	**.20**	**.40**	**1.05**	.....
" (ic) **Citrate** pearls U. S. P	**.25**	**.55**	**1.60**	.....
" " **Ferrocyanide**—Prussian Blue Soluble	**.20**	**.45**	**1.25**	.....
" " **Fluoride C. P.**	**.30**	**.75**	**2.25**	.....
" " **Hydroxide C. P.**	**.20**	**.35**	**1.00**	.....
" (ous) **Iodide**	**.75**	....	....	.....
" (ic) **Nitrate** cryst. **C. P.**	**.20**	**.40**	**1.20**	.....
" (ous) **Nitrate Solution**	**.20**	**.35**	**.90**	.....
" (ic) **Oxalate** pearls	**.25**	**.55**	**1.65**	.....
" (ous) " powder	**.20**	**.40**	**1.20**	.....
" (ic) **Oxide** red tech. (Crocus Martis)	....	....	**.25**	**.85**
" " " " pure (Jeweler's Rouge)	....	**.25**	**.60**	**2.50**
" " " " **C. P.**	....	**.30**	**.70**	**3.00**
" (ous) " black **C. P.**	**.40**	**1.10**	**3.25**	.....
" (ic-ous) " pure magnetic	....	**.25**	**.50**	**2.00**
" (ic) **Phosphate** soluble pearls U. S. P	**.25**	**.45**	**1.30**	.....
" (ous) " powd	**.20**	**.30**	**.90**	.....
" (ic) **Potassium Oxalate C. P.**	**.25**	**.60**	**1.70**	.....
" " " **Sulphate C. P.**	**.20**	**.45**	**1.35**	.....
" " **Sodium Oxalate C. P.**	**.25**	**.55**	**1.60**	.....
" " " **Sulphate C. P.**	....	**.35**	**.90**	.....
" " **Sulphate** basic dry	....	**.30**	**.65**	.....
" " " normal **C. P.**	....	**.30**	**.75**	**3.50**
" (ous) " cryst. tech. (Copperas)	....	....	**.20**	**.60**
" " " " U. S. P	....	....	**.30**	**1.15**
" " " " **C. P.**	....	**.25**	**.55**	**2.15**
" " " anhyd. U. S. P	....	**.20**	**.35**	**1.40**
" " " " **C. P.**	**.20**	**.45**	**1.25**	.....
" " **Sulphide** lump	....	....	**.20**	**.75**
" " " gran	....	....	**.25**	**.95**
" (ic) " Iron Pyrites	....	....	**.30**	**1.25**
" (ous) " sticks	....	....	**.30**	**1.10**
" " **Sulphite C. P.**	**.25**	**.65**	**1.90**	.....
" (ic) **Tartrate** scales	**.30**	**.80**	**2.40**	.....
Javelle Water—see Sodium Hypochlorite	....	....	....	.....
Junket Tablets ..... 10 in vial, **$0.20**; 100 in bottle, **.90**	....	....	....	.....
Kaolin powd	....	....	**.20**	**.60**
" U. S. P	....	....	**.30**	**1.15**
" washed in acid	**.20**	**.45**	**1.35**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Kerosene	....	....	**$0.30**	1 Gal. **$0.75**
Kieselguhr—see Infusorial Earth	....	....	....	.....
Lacmoid scales	**$2.00**	....	....	¼ oz. **.75**
Lactose (Milk Sugar) powd	....	**$0.30**	**.60**	**2.50**
" powd. **C. P.**	**.20**	**.35**	**1.00**	.....
" Bacto	....	**1.00**	**3.00**	½ lb. **1.75**
Lampblack	....	**.25**	**.50**	.....
Lead Bars	....	....	**.35**	**1.50**
" com'l sheet 1/16 in	....	....	**.35**	**1.35**
" **Shot** No. 10	....	....	**.30**	**1.25**
" **Foil** (tea lead)	....	**.20**	**.40**	**1.50**
" **Test Ag.** free gran	....	**.30**	**.60**	**2.50**
" " " " foil	....	**.35**	**1.05**	.....
" **Acetate** normal cryst. tech	....	**.20**	**.45**	**1.65**
" " " " U. S. P	....	**.25**	**.50**	**2.25**
" " " " **C. P.**	....	**.35**	**.75**	**3.00**
" " " powd. tech	....	**.20**	**.45**	**1.65**
" " " " U. S. P	....	**.25**	**.50**	**2.25**
" " (sub) basic **C. P.** for Sugar Analysis	....	**.30**	**.70**	.....
" " **Monobasic C. P.**	**.20**	**.45**	**1.30**	.....
" **Arsenate** dry powd	....	**.25**	**.50**	**2.15**
" " **C. P.**	**.20**	**.50**	**1.50**	.....
" **Borate C. P.**	**.30**	**.80**	**2.40**	.....
" **Bromide C. P.**	**.50**	**1.40**	....	.....
" **Carbonate** (White Lead)	....	**.20**	**.35**	**1.35**
" " **C. P.**	**.20**	**.45**	**1.25**	.....
" **Chloride C. P.**	**.20**	**.40**	**1.20**	.....
" **Chromate** (Chrome Yellow)	....	**.20**	**.45**	**1.75**
" " **C. P.**	**.20**	**.40**	**1.20**	.....
" " fused lump **C. P.**	**.25**	**.55**	**1.60**	.....
" **Cyanide** pure	**.35**	**.85**	**2.50**	.....
" **Dioxide**—see Lead Oxide brown	....	....	....	.....
" **Ferrocyanide** pure	**.30**	**.70**	**2.00**	.....
" **Hydroxide C. P.**	**.20**	**.35**	**.95**	.....
" **Iodide** U. S. P	**.60**	**1.75**	**5.25**	.....
" **Nitrate** cryst. tech	....	**.20**	**.45**	**1.75**
" " **C. P.**	....	**.35**	**.80**	**3.65**
" **Oxalate C. P.**	**.30**	**.70**	**2.10**	.....
" **Oxide** Di-Brown tech	....	**.25**	**.65**	**2.75**
" " Mn. free **C. P.**	**.20**	**.45**	**1.30**	.....
" Mono-Yellow (Litharge)	....	**.20**	**.35**	**1.35**
" " " **C. P.**	....	**.30**	**.60**	**2.50**
" Red (minium)	....	**.20**	**.35**	**1.35**
" " **C. P.**	....	**.30**	**.60**	**2.50**
" **Peroxide**—see Lead Oxide Di-Brown	....	....	....	.....
" **Phosphate C. P.**	**.30**	**.60**	**1.75**	.....
" **Silicate** pure	**.20**	**.45**	**1.35**	.....
" **Silicofluoride C. P.**	**.20**	**.45**	**1.25**	.....
" **Subacetate**—see Lead Acetate basic	....	....	....	.....
" **Sulphate** pure	**.20**	**.35**	**.95**	.....
" " **C. P.**	**.25**	**.40**	**1.10**	.....
" **Sulphide** native Galena	....	**.25**	**.50**	.....
" " **C. P.**	**.35**	**.90**	**2.70**	.....
" **Sulphite C. P.**	**.25**	**.55**	**1.55**	.....
" **Tartrate C. P.**	**.30**	**.75**	**2.25**	.....
Levulose dry powder (Diabetin)	**.50**	**1.50**	**4.50**	.....
" syrup	**.45**	**1.25**	**3.75**	.....
Lime—see Calcium Oxide	....	....	....	.....
" **Chlorinated**—see Calcium Hypochlorite	....	....	....	.....
" **Water**—see Water Lime	....	....	....	.....
Litharge—see Lead Oxide mono	....	....	....	.....
Lithium Acetate pure	**.45**	**1.30**	**3.90**	.....
" **Bromide** U. S. P	**.45**	**1.20**	**3.50**	.....
" **Carbonate** U. S. P	**.35**	**.95**	**2.80**	.....
" **Chloride C. P.**	**.40**	**1.25**	**3.75**	.....
" **Fluoride C. P.**	**.70**	**2.10**	**6.30**	.....
" **Hydroxide C. P.**	**.80**	**2.50**	....	.....
" **Iodide** U. S. P	**.90**	**2.70**	....	.....
" **Nitrate C. P.**	**.40**	**1.10**	**3.25**	.....
" **Salicylate** U. S. P	**.35**	**1.00**	**3.00**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Lithium Sulphate C. P.	$0.40	$1.10	$3.30	.....
" **Tartrate**	.55	1.60	4.70	.....
Litmus Cubes blue	.20	.50	1.50	.....
" **Powder** blue	.25	.45	1.40	.....
" " red	.25	.60	1.80	.....
" **Purified**	.90	2.60	....	.....
" **Paper**—see Test Papers	....	....	....	.....
Logwood Chips	....	.20	.30	$1.25
" **Extract**	....	.35	.95	.....
Lycopodium powd	.25	.60	1.75	.....
Lysol genuine	....	....	1.10	3 oz. .30
Magnesium Metal powd	.35	1.00	2.75	.....
" " ribbon	.50	1.85	....	.....
" " turnings for Grignard reaction	.40	1.15	3.35	.....
" **Acetate C. P.**	.25	.55	1.65	.....
" **Ammonium Chloride C. P.**	.20	.45	1.25	.....
" " **Phosphate C. P.**	.20	.40	1.20	.....
" " **Sulphate C. P.**	.20	.40	1.20	.....
" **Borate C. P.**	.25	.65	2.00	.....
" **Bromide** cryst. pure	.40	1.00	2.90	.....
" **Carbonate** 2 oz. cubes	....	.30	.65	.....
" powd. light pure	....	.20	.40	1.50
" **C. P.**	.20	.40	1.20	.....
" **Chloride** cryst. pure	....	.25	.45	1.95
" " **C. P.**	....	.30	.65	2.90
" fused **C. P.**	.20	.40	1.00	.....
" **Chromate C. P.**	.45	1.40	4.20	.....
" **Citrate C. P.**	.40	1.00	3.00	.....
" **Fluoride C. P.**	.50	1.35	4.00	.....
" **Formate C. P.**	.35	.95	2.80	.....
" **Iodide**	.90	....	....	.....
" **Nitrate C. P.**	.20	.30	.75	.....
" **Oxalate C. P.**	.30	.70	2.00	.....
" **Oxide** light U. S. P	....	.40	1.00	.....
" tech. heavy, powder	....	....	.30	1.00
" heavy U. S. P	....	.40	1.00	.....
" **C. P.**	.40	1.00	3.00	.....
" and **Sodium Carbonate C. P.** (Eschka's Mixt.)	.35	.90	2.70	.....
" **Peroxide**	.35	.85	2.50	.....
" **Phosphate Monobasic C. P.** Mg. $H_4 (PO_4)_2$	.30	.80	2.35	.....
" **Dibasic C. P.** Mg. HPO_4+Aq	.20	.40	1.20	.....
" **Tribasic C. P.** $Mg_3 (PO_4)_2$	.25	.65	1.95	.....
" **Pyrophosphate C. P.**	.30	.75	2.15	.....
" **Silicate** tech. powder	....	.20	.35	1.50
" **C. P.**	.25	.60	1.75	.....
" **Silicofluoride C. P.**	.30	.70	2.10	.....
" **Sulphate** cryst. (Epsom salts) U. S. P	....	....	.20	.60
" " **C. P.**	....	.25	.50	1.90
" dry powd	....	.20	.30	1.30
" anhyd. **C. P.**	.20	.40	1.15	.....
" **Sulphite** pure	.20	.35	.95	.....
" **Tartrate C. P.**	.35	1.00	3.00	.....
" **Thiocyanate C. P.**	1.00	3.00	....	.....
Maltose (Malt sugar) pure	.25	.50	1.50	.....
" " " **C. P.**	....	....	....	25 Gm. 1.50
Manganese Metal 81% tech	....	.25	.50	.....
" " pure	.20	.45	1.25	.....
" **Acetate C. P.**	.45	1.30	3.90	.....
" **Ammonium Chloride C. P.**	.25	.60	1.75	.....
" " **Sulphate C. P.**	.20	.35	1.00	.....
" **Borate C. P.**	.30	.85	2.50	.....
" **Bromide** pure	.55	1.60	....	.....
" **Carbonate C. P.**	.25	.55	1.60	.....
" **Chloride** cryst. tech	....	.25	.55	2.30
" " " **C. P.**	.20	.35	.90	.....
" **Dioxide** gran	....	....	.20	.75
" " lump	....	....	.30	1.15
" " powd	....	....	.20	.75
" " **C. P.**	.20	.35	.75	3.25
" **Hydroxide** pure	.25	.50	1.50	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Manganese Iodide	$0.90	....	....	.....
" **Nitrate C. P.**	.25	$0.55	$1.65	.....
" **Oxalate C. P.**	.30	.75	2.20	.....
" **Peroxide**—see Manganese Dioxide	....	....	....	.....
" **Phosphate C. P.**	.35	1.00	3.00	.....
" **Sulphate** pure	....	.25	.55	$2.30
" " **C. P.**	.20	.35	.90	.....
" **Sulphide**	.30	.85	2.50	.....
Mannite pure	.50	1.50	4.50	.....
Marble lump or dust—see Calcium Carbonate	....	....	....	.....
Melampyrite—see Dulcit	....	....	....	.....
Menthol cryst	.90	....	....	.....
Mercurochrome cryst	....	....	....	10 Gm. 1.90
" Tablets 4.6 gm .30 in bot., $1.90.	....	....	....	.....
" Solution 2%	.35	1.00	3.00	.....
Mercury Metal Virgin grade	....	.95	2.90	13.50
" " redistilled	....	1.10	3.15	14.50
" " **C. P.**	....	1.25	3.75	.....
" (ic) **Acetate C. P.**	.50	1.45	4.25	.....
" (ous) " pure	.65	1.55	4.50	.....
" (ic) **Biniodide**—see Mercury Iodide Red	....	....	....	.....
" " **Bromide C. P.**	.75	2.25	....	.....
" " **Chloride** gran. U. S. P	.30	.90	2.75	.....
" " " **C. P.**	.35	1.05	3.15	.....
" (ous) " (Calomel) U. S. P	.40	1.10	3.25	.....
" " " " **C. P.**	.40	1.15	3.50	.....
" (ic) **Chromate C. P.**	.85	....	....	.....
" " **Cyanide** cryst. **C. P.**	.55	1.60	4.75	.....
" " **Iodide** red U. S. P	.70	2.40	7.50	.....
" (ous) " green U. S. P	.70	2.40	....	.....
" " " yellow U. S. P	.70	2.40	....	.....
" (ic) **Nitrate** cryst. **C. P.**	.45	1.20	3.50	.....
" (ous) " cryst. **C. P.**	.45	1.25	3.60	.....
" (ic) **Oxide** red U. S. P	.40	1.15	3.35	.....
" " " " **C. P.**	.45	1.25	3.75	.....
" " " yellow **C. P.**	.50	1.45	4.30	.....
" (ous) " black **C. P.**	.60	1.80	5.30	.....
" **Potassium Iodide**	.90	....	....	.....
" **Sub-Sulphate**—see Mercury (ic) Sulphate basic	....	....	....	.....
" (ic) **Sulphate** normal	.35	.95	2.75	.....
" " " " **C. P.**	.40	1.10	3.20	.....
" (ous) " **C. P.**	.50	1.40	4.20	.....
" (ic) **Sulphide** black (Ethiop's Mineral)	.35	.90	2.60	.....
" " " red (Artif. Cinnabar)	.45	1.35	4.00	.....
" " " red **C. P.**	.55	1.55	4.60	.....
" " **Sulphocyanate** (Thiocyanate)	.40	1.20	3.60	.....
Metals Fusible—see Alloys	....	....	....	.....
Methyl Acetate pure	.20	.40	1.10	.....
" **Alcohol**—see Alcohol Methyl	....	....	....	.....
" **Benzoate**	.35	1.00	3.00	.....
" **Bromide**	.30	.70	2.00	.....
" **Iodide**	1.20	3.40	....	.....
" **Orange** (indicator)	.60	1.80	....	.....
" **Red** pure	1.20	....	....	.....
" **Salicylate**—see Oil Wintergreen	....	....	....	.....
" **Sulphate**—see Dimethyl Sulphate	....	....	....	.....
Methylamine Solution 33%	2.50	....	....	.....
" **Hydrochloride**	4.00	....	....	.....
Metol (Photographic Developer)	.60	1.80	....	.....
Microcosmic Salts—see Sodium Ammonium Phosphate	....	....	....	.....
Milk Sugar—see Lactose	....	....	....	.....
Mineral Wool	....	....	.25	.75
Minium—see Lead Oxide red	....	....	....	.....
Mohr's Salt—see Iron (ous) Ammonium Sulphate	....	....	....	.....
Molasses Kettle Rendered	....	....	....	1 pt. .30
Molybdenum Metal 95% powd	1.75	....	....	.....
" **Oxide** (sesqui) pure	2.50	....	....	.....
" **Trioxide**—see Acid Molybdic	....	....	....	.....
Monobrom Benzene	.30	.70	2.00	.....
Monochlor Benzene	.20	.30	.90	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Naphthalene Balls	....	$0.20	$0.30	$1.25
" white flakes	....	....	.25	1.00
Naphthol Alpha tech	$0.30	.85	2.40	.....
" " recryst	.40	1.00	3.00	.....
" **Beta** resub. U. S. P.	.20	.45	1.25	.....
" " **Nitroso**—see Nitrosobeta Naphthol	....	....	....	.....
Naphthylamine Alpha tech	.25	.50	1.45	.....
" " **Hydrochloride C. P.**	.55	1.60	4.80	.....
" **Beta** tech	.30	.85	2.50	.....
" " **Hydrochloride**	.90	2.70	....	.....
Nickel Metal gran	.20	.35	1.00	.....
" " " **C. P.**	.20	.50	1.40	.....
" " powd	.25	.55	1.60	.....
" **Acetate C. P.**	.30	.85	2.55	.....
" **Ammonium Chloride C. P.**	.25	.65	2.00	.....
" " **Sulphate** tech	....	.20	.35	1.35
" " " **C. P.**	.20	.30	.70	3.00
" **Borate C. P.**	.45	1.40	4.20	.....
" **Bromide** pure	.50	1.35	4.00	.....
" **Carbonate** tech	.20	.35	1.00	.....
" " **C. P.**	.30	.80	2.40	.....
" **Chloride** cryst. tech	.20	.30	.90	.....
" " " **C. P.**	.25	.55	1.60	.....
" **Cyanide C. P.**	.45	1.40	4.20	.....
" **Fluoride C. P.**	.35	1.05	3.15	.....
" **Hydroxide C. P.**	.50	1.45	4.30	.....
" **Nitrate** cryst. **C. P.**	.25	.50	1.40	.....
" **Oxalate C. P.**	.40	1.20	3.60	.....
" **(ic) Oxide** black pure	.25	.50	1.50	.....
" " " " **C. P.**	.30	.70	2.00	.....
" **(ous)** " green pure	.25	.60	1.75	.....
" " " " **C. P.**	.30	.70	2.00	.....
" **Phosphate C. P.**	.45	1.30	3.80	.....
" **Sulphate** cryst. tech	....	.20	.35	1.35
" " " **C. P.**	.20	.35	1.00	.....
" **Sulphide C. P.**	.35	1.00	3.00	.....
" **Tartrate C. P.**	.35	1.00	3.00	.....
Nicotine Sulphate 40%	....	.95	2.25	.....
Ninhydrin	....	....	....	1/10 Gm. 1.60
Nitraniline Meta tech	.35	1.00	3.00	.....
" **Ortho C. P.**	3.25	....	....	.....
" **Para**	.35	1.00	3.00	.....
Nitrobenzaldehyde Meta pure	1.20	3.50	....	.....
Nitrobenzene Rectif. (Oil Mirbane)	....	.30	.55	2.25
Nitron	....	....	....	1 Gm. 1.00
Nitrophenol Ortho	.45	1.35	4.00	.....
" **Para**	.35	1.00	3.00	.....
Nitrosobetanapthhol	.85	2.80	....	.....
Nutgall whole	.20	.30	.75	.....
" powd	.20	.35	.90	.....
Nutrose	1.00	....	....	.....
Oil Almond Bitter true	.75	....	....	.....
" " " Artif.—see Benzaldehyde	....	....	....	.....
" **Aniline**—see Aniline pure	....	....	....	.....
" **Bergamot**	.70	....	....	.....
" **Birch** sweet—see Oil Wintergreen Natural	....	....	....	.....
" **Cajeput**	.45	1.35	....	.....
" **Castor**	....	.35	.60	.....
" **Cedar Leaf**	.35	.90	2.60	.....
" " **Wood** for clearing	.25	.55	1.50	.....
" " " " immersion	.45	1.25	3.75	.....
" **Cinnamon Cassia**	.75	....	....	.....
" **Cloves**	.45	1.25	3.75	.....
" **Cocoanut**	....	.30	.60	2.50
" **Corn**	....	.30	.60	.....
" **Cotton Seed**	....	.25	.50	2.25
" **Crude** (Crude Petroleum)	....	....	.40	1.35
" **Fusel rectified**—see Alcohol Amyl	....	....	....	.....
" **Lavender** Flowers Extra	.60	....	....	.....
" **Lemon**	.35	1.00	3.00	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Oil Linseed boiled ..... 1 pt. **$0.45,** 1 qt. **$0.80**	....	....	....	1 gal. **$2.25**
" " raw ..... 1 pt. **.45,** 1 qt. **.80**	....	....	....	1 gal. **2.25**
" **Neatsfoot**	....	**$0.30**	**$0.65**	.....
" **Olive** best Italian	....	**.35**	**.80**	.....
" **Origanum** comp	**$0.30**	**.70**	**2.00**	.....
" **Palm** red	....	**.30**	**.60**	.....
" **Paraffin** yellow	....	....	**.40**	**1.00**
" " white	....	....	**.50**	**1.35**
" **Peanut**	....	**.30**	**.75**	.....
" **Peppermint** U. S. P	**.60**	**1.80**	....	.....
" **Sassafras** U. S. P	**.50**	....	....	.....
" " Artif	**.25**	**.50**	**1.50**	.....
" **Thyme** white	**.35**	**1.00**	**3.00**	.....
" " red	**.35**	**1.00**	**3.00**	.....
" **Turpentine** pure ..... 1 pt. **.45,** 1 qt. **.75**	....	....	....	1 gal. **1.75**
" " Rectified U. S. P	....	**.35**	**.80**	.....
" **Wintergreen** true (sweet birch)	**.50**	....	....	.....
" " synthetic (Methyl Salicylate)	**.20**	**.40**	**1.00**	.....
Orcein cryst	....	....	....	10 Gm. **2.00**
Orcinol (Orcin)	....	....	....	10 Gm. **2.25**
Osmium Tetroxide—see Acid Osmic Anhydride	....	....	....	.....
Ox-Gall powd. pure	**.40**	**1.00**	**3.00**	.....
" **Bacto**	....	**1.25**	**4.15**	.....
Oxone Cubes—see Sodium Peroxide Fused	....	....	....	.....
Pancreatin U. S. P. powder	**.45**	**1.25**	**3.75**	.....
" **Liquid**	**.30**	**.80**	**2.00**	.....
Papain (Papayotin)	**1.00**	....	....	.....
Paper Test—see Test Paper	....	....	....	.....
" **Parchment**—see Parchment Paper	....	....	....	.....
Paraffine medium	....	....	**.25**	**.90**
" soft	....	....	**.20**	**.80**
" liquid—see Oil Paraffine	....	....	....	.....
Paraformaldehyde—see Formaldehyde Para	....	....	....	.....
Paraldehyde U. S. P	**.20**	**.40**	**1.25**	.....
Parchment Paper medium	....	**.30**	**.60**	**2.25**
Paris Green—see Copper Acetoarsenite	....	....	....	.....
Pepsin powd. U. S. P	**.50**	**1.50**	**4.40**	.....
" scales U. S. P	**.60**	**1.75**	....	.....
" Solution	**.30**	**.75**	**2.25**	.....
Peptone dry from Meat	**.35**	**.80**	**2.40**	.....
" **Bacto**	**.60**	....	**6.00**	½ lb. **3.50**
" **Witte's**	**.80**	**2.40**	**8.00**	.....
Petrolatum yellow	....	....	**.40**	**1.50**
" white	....	....	**.50**	**2.00**
Petroleum Crude—see Oil Crude	....	....	....	.....
" **Ether**—see Ether Petrolic	....	....	....	.....
Phenol—see Acid Carbolic	....	....	....	.....
Phenolphthalein U. S. P	**.35**	**.75**	**2.25**	.....
" **C. P.**	**.40**	**1.00**	**3.00**	.....
Phenylenediamine Meta tech	**.45**	**1.20**	**3.50**	.....
" " **Hydrochloride C. P.**	**2.00**	....	....	.....
" **Para** tech	**.60**	**1.70**	**5.00**	.....
" " **Hydrochloride C. P.**	**.60**	**1.70**	**5.00**	.....
Phenylhydrazine Base	**1.25**	**4.00**	....	.....
" **Hydrochloride**	**1.25**	**4.00**	....	.....
Phloroglucin (Phloroglucinol)	....	....	....	10 Gm. **3.50**
Phosphoric Anhydride—see Acid Phosphoric Anhydride	....	....	....	.....
Phosphorus Yellow sticks	**.35**	**.60**	**1.40**	.....

NOTE: Phosphorus Yellow Sticks can be shipped only by freight. Express or Parcel Post shipments are prohibited by law.

Phosphorus Red Amorph	**.35**	**.60**	**1.40**	.....
" **Oxychloride C. P.**	**.45**	**.90**	**1.90**	.....
" **Pentachloride C. P.**	**.45**	**.75**	**1.70**	.....
" **Pentasulphide C. P.**	**.45**	**1.20**	**3.50**	.....
" **Pentoxide**—see Acid Phosphoric Anhydride	....	....	....	.....
" **Trichloride C. P.**	**.45**	**.75**	**1.85**	.....
" **Sesquisulphide**	**.35**	**.70**	**1.90**	.....
Phthalic Anhydride—see Acid Phthalic Anhydride	....	....	....	.....
Pipe Clay—see Kaolin	....	....	....	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Plaster Paris—see Calcium Sulphate Calcined	....	....	....	.....
Platinum Foil or Wire—see page 453	....	....	....	.....
" **Asbestos** 5%—see Asbestos Platinized	....	....	....	.....
" **(ic) Chloride C. P.** dry	....	....	....	1 Gm. **$2.50**
" " " Solution 5%	**$3.25**	....	....	.....
" " " " 10%	**6.25**	....	....	.....
Plumbago—see Graphite	....	....	....	.....
Potassium Metal Balls	**1.80**	....	....	¼ oz. **.70**
" **Acetate** U. S. P	**.20**	**$0.30**	**$0.75**	.....
" " **C. P.**	**.20**	**.35**	**1.00**	.....
" **Acid Tartrate**—see Potassium Bitartrate	....	....	....	.....
" **Alum**—see Aluminum Potassium Sulphate	....	....	....	.....
" **Ammonium Phosphate C. P.**	**.25**	**.60**	**1.75**	.....
" " **Sulphate C. P.**	**.25**	**.65**	**1.85**	.....
" **Antimoniate C. P.**	**.30**	**.80**	**2.40**	.....
" **Antimony Tartrate** U. S. P. (Tartar Emetic)	**.20**	**.30**	**.70**	.....
" " **C. P.**	**.25**	**.60**	**1.50**	.....
" **Arsenate** cryst. **C. P.**	**.30**	**.80**	**2.45**	.....
" **Arsenite C. P.**	**.30**	**.75**	**2.20**	.....
" **Benzoate** pure	**.40**	**.95**	**2.75**	.....
" **Bicarbonate** cryst. U. S. P	....	**.20**	**.40**	.....
" " **C. P.**	**.20**	**.30**	**.70**	.....
" **Bichromate** cryst. tech	....	**.20**	**.35**	**1.45**
" " **C. P.**	**.20**	**.30**	**.75**	**3.25**
" **Binoxalate** cryst	**.20**	**.30**	**.60**	.....
" **C. P.**	**.20**	**.45**	**1.35**	.....
" **Biphosphate C. P.**—see Potassium Phosphate Mono	....	....	....	.....
" **Bisulphate** cryst. **C. P.**	**.20**	**.30**	**.75**	.....
" **fused C. P.**	**.20**	**.35**	**.80**	.....
" " powd. **C. P.**	**.20**	**.35**	**.95**	.....
" **Bisulphite C. P.**	**.20**	**.35**	**.95**	.....
" **Bitartrate** powd. (Cream Tartar) U. S. P	....	**.25**	**.55**	**2.50**
" **C. P.**	**.20**	**.35**	**1.00**	.....
" **Borate C. P.**	**.30**	**.75**	**2.15**	.....
" **Bromate C. P.**	**.30**	**.70**	**1.90**	.....
" **Bromide** gran. U. S. P	**.20**	**.30**	**.80**	.....
" cryst. **C. P.**	**.20**	**.40**	**1.10**	.....
" **Carbonate** U. S. P. (Salts Tartar)	....	**.25**	**.45**	**2.00**
" cryst. **C. P.**	**.20**	**.30**	**.65**	**2.75**
" Anhyd. **C. P.**	**.20**	**.30**	**.75**	**3.25**
" **Chlorate** cryst. pure	....	**.20**	**.30**	**1.25**
" " **C. P.**	....	**.30**	**.60**	**2.50**
" powd. pure	....	**.20**	**.30**	**1.25**
" **Chloride** pure white	....	**.20**	**.30**	**1.15**
" **C. P.**	....	**.30**	**.60**	**2.50**
" **Chromate** cryst. pure	**.20**	**.30**	**.65**	**2.75**
" " **C. P.**	**.20**	**.40**	**1.00**	.....
" **Chromium Sulphate**—see Chromium Potassium Sulph	....	....	....	.....
" **Citrate** U. S. P	**.20**	**.35**	**1.00**	.....
" **C. P.**	**.25**	**.55**	**1.60**	.....
" **Cyanate C. P.**	**.80**	**2.50**	**7.50**	.....
" **Cyanide** fused 98-100% pure	**.20**	**.40**	**1.20**	.....
" **C. P.**	**.25**	**.60**	**1.80**	.....
" **Dichromate**—see Potassium Bichromate	....	....	....	.....
" **Ethyl Sulphate** pure	**.60**	**1.80**	....	.....
" **Ferricyanide** cryst. red pure	**.20**	**.35**	**.90**	.....
" " **C. P.**	**.25**	**.50**	**1.50**	.....
" **Ferrocyanide** cryst. yellow pure	**.20**	**.30**	**.60**	**2.50**
" " **C. P.**	**.20**	**.40**	**1.20**	.....
" **Fluoride** cryst. **C. P.**	**.30**	**.65**	**1.50**	.....
" **Formate C. P.**	**.30**	**.70**	**2.00**	.....
" **Hydroxide** Sticks U. S. P	....	**.25**	**.65**	**2.75**
" " **C. P.**	....	**.40**	**.85**	**3.75**
" **Pellets** U. S. P	....	**.35**	**.65**	**2.75**
" " **C. P.**	....	**.40**	**.85**	**3.75**
" **Iodate C. P.**	**.70**	**2.10**	....	.....
" **Iodide** cryst. U. S. P	**.60**	**1.85**	**5.50**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Potassium Iodide cryst. **C. P.**	**$0.70**	**$2.10**	**$6.25**	.....
" **Metabisulphite** pure	**.20**	**.30**	**.55**	.....
" **Molybdate C. P.**	**.75**	....	....	.....
" **Nitrate** cryst. pure	....	**.20**	**.30**	**$1.15**
" " " **C. P.**	....	**.30**	**.60**	**2.50**
" " powd. pure	....	**.20**	**.30**	**1.15**
" " Fused Stick **C. P.**	**.20**	**.50**	**1.50**	.....
" **Nitrite** cryst. pure	**.20**	**.40**	**1.10**	.....
" " " **C. P.**	**.25**	**.50**	**1.45**	.....
" " Sticks **C. P.**	**.25**	**.55**	**1.65**	.....
" **Oxalate** Neutral cryst. pure	**.20**	**.30**	**.65**	.....
" " " " **C. P.**	**.20**	**.40**	**1.15**	.....
" " **Acid**—see Potassium Binoxalate	....	....	....	.....
" **Perchlorate C. P.**	**.20**	**.40**	**1.15**	.....
" **Permanganate** cryst. U. S. P	....	**.25**	**.45**	**1.85**
" " " **C. P.**	**.20**	**.35**	**.80**	.....
" **Persulphate C. P.**	**.20**	**.40**	**1.10**	.....
" **Phosphate** Monobasic **C. P.** KH_2PO_4	**.20**	**.40**	**1.15**	.....
" " Dibasic **C. P.** $K_2H\ PO_4$	**.25**	**.45**	**1.40**	.....
" " Tribasic **C. P.** K_3PO_4	**.30**	**.55**	**1.65**	.....
" **Pyrophosphate C. P.**	**.30**	**.60**	**1.80**	.....
" **Silicate** dry **C. P.**	**.30**	**.60**	**1.85**	.....
" **Silicofluoride C. P.**	**.35**	**.85**	**2.45**	.....
" **Sulphate** cryst. pure	....	**.20**	**.40**	**1.65**
" " " **C. P.**	....	**.30**	**.60**	**2.50**
" " powd. pure	....	**.20**	**.40**	**1.65**
" **Sulphide** cryst. **C. P.**	**.25**	**.50**	**1.50**	.....
" " fused gran	....	**.30**	**.60**	.....
" **Sulphite C. P.**	**.20**	**.45**	**1.25**	.....
" **Sulphocyanate C. P.**	**.25**	**.50**	**1.40**	.....
" **Tartrate** Neutral pure	**.20**	**.40**	**1.10**	.....
" " " cryst. **C. P.**	**.30**	**.60**	**1.75**	.....
" **Tetroxalate C. P.**	**.30**	**.55**	**1.65**	.....
" **Thiocyanate**—see Potassium Sulphocyanate	....	....	....	.....
Propyl Acetate Normal	**1.20**	**3.50**	....	.....
" **Alcohol**—see Alcohol Propyl	....	....	....	.....
" **Iodide** Normal	**3.00**	....	....	.....
" " **Iso**	**2.75**	....	....	.....
Propylamine—see Trimethylamine 33% Solution	....	....	....	.....
Prussian Blue—see Iron Ferrocyanide	....	....	....	.....
Ptyalin	**2.50**	....	....	.....
Pumice lump	....	**.20**	**.35**	**1.35**
" powd	....	....	**.30**	**1.15**
Pyridine (Base) tech	**.30**	**.60**	**1.80**	.....
Pyrocatechin Resub	**1.05**	....	....	.....
Pyrogallol—see Acid Pyrogallic	....	....	....	.....
Pyroxylin (Celloidin)	**1.15**	....	....	.....
Quicklime—see Calcium Oxide	....	....	....	.....
Quicksilver—see Mercury	....	....	....	.....
Quinine Alkaloid U. S. P	**1.15**	....	....	.....
" **Hydrochloride** U. S. P	**1.05**	....	....	.....
" **Sulphate** U. S. P	**1.00**	....	....	.....
Quinol—see Hydroquinone	....	....	....	.....
Raffinose C. P.	....	....	....	10 Gm. **7.30**
Red Lead—see Lead Oxide Red	....	....	....	.....
" **Precipitate**—see Mercury (ic) Oxide	....	....	....	.....
Rennin powd. 1:30000	**.80**	**2.40**	....	.....
" Liquid	**.30**	**.85**	**2.50**	.....
" Tablets, 1 Grain 10 in vial, **$0.20**	....	....	....	100 **.90**
Resorcin recryst. White U. S. P	**.45**	**1.15**	**3.50**	.....
" Resub. U. S. P	**.45**	**1.15**	**3.50**	.....
Rhamnose (Isodulcit)	....	....	....	10 Gm. **4.00**
Rochelle Salt—see Sodium and Potassium Tartrate	....	....	....	.....
Rock Candy White—see Saccharose cryst	....	....	....	.....
" **Salt** coarse cryst	....	....	**.20**	**.50**
Rosin Yellow lump	....	....	**.25**	**.90**
" " powd	....	....	**.30**	**1.25**
Rubber (Caoutchouc) Crude Sheet	....	**.45**	**1.25**	.....
" **Cement**	**.25**	**.75**	....	.....
Saccharin refined U. S. P	**.40**	**1.10**	**3.30**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Saccharose gran	....	....	**$0.20**	**$0.70**
" cryst. (Rock Candy)	....	**$0.20**	**.45**	**2.00**
" " **C. P.**	**$0.20**	**.40**	**1.10**	.....
Salol U. S. P	**.30**	**.60**	**1.75**	.....
Sal Ammoniac—see Ammonium Chloride	....	....	....	.....
Sal Tartar—see Potassium Carbonate	....	....	....	.....
Salt—see Sodium Chloride	....	....	....	.....
" **Rochelle**—see Sodium Potassium Tartrate	....	....	....	.....
Saltpetre—see Potassium Nitrate	....	....	....	.....
Sand Sea yellow	....	....	**.20**	**.45**
" " white	....	....	**.20**	**.45**
" " washed and ignited	....	**.25**	**.60**	**2.50**
Saponin crude	**.30**	**.75**	**2.20**	.....
" Purif. white	**.35**	**.90**	**2.70**	.....
Sealing Wax—see Wax sealing	....	....	....	.....
Sea Sand—see Sand	....	....	....	.....
Selenium sticks	**.60**	**1.65**	**5.00**	.....
" powd	**.65**	**1.75**	**5.25**	.....
" **(ous) Hydroxide**—see Acid Selenous	....	....	....	.....
" **Oxychloride**	**1.10**	**3.35**	....	.....
Shellac—see Gum Shellac	....	....	....	.....
Silica powd	....	....	**.20**	**.75**
" pure—see Acid Silicic	....	....	....	.....
Silicon fused	....	**.30**	**.60**	.....
" **Carbide**—see Carborundum	....	....	....	.....
" **Dioxide**—see Silica	....	....	....	.....
Silver Metal foil pure	**1.40**	....	....	.....
" " gran. "	**1.40**	....	....	.....
" " powd. precip	**1.85**	....	....	.....
" **Acetate** pure	**1.40**	....	....	.....
" **Bromide** pure	**1.30**	....	....	.....
" **Carbonate** pure	**1.35**	....	....	.....
" **Chloride** pure	**1.15**	**3.40**	....	.....
" **Cyanide** U. S. P	**1.15**	**3.40**	....	.....
" **Iodide** pure	**1.35**	....	....	.....
" **Nitrate** cryst. **C. P.**	**.90**	**2.80**	**9.00**	.....
" **Nitrite** pure	**1.75**	...	....	.....
" **Oxide** U. S. P	**1.50**	....	....	.....
" **Phosphate** U. S. P	**1.50**	....	....	.....
" **Sulphate** pure	**1.15**	....	....	.....
Slag Wool—see Mineral Wool	....	....	....	.....
Soap Castile white bars	....	**.30**	**.70**	.....
" " " powd	**.20**	**.35**	**.90**	.....
" **Soft**—(Green Soap) U. S. P	....	....	**.50**	**2.00**
Soda Ash—see Sodium Carbonate Anhyd	....	....	....	.....
" **Baking**—see Sodium Bicarbonate	....	....	....	.....
" **Lime**—see Sodium Calcium Hydrate	....	....	....	.....
" **Washing**—see Sodium Carbonate	....	....	....	.....
Sodium Metal	**.40**	**.55**	**1.20**	.....
" " **C. P.**	**.50**	**.70**	**1.65**	.....
" **Acetate** cryst. tech	....	**.20**	**.30**	**1.25**
" " " **C. P.**	....	**.30**	**.60**	**2.50**
" " fused Anhyd. **C. P.**	**.20**	**.40**	**1.05**	.....
" " " cryst. **C. P.**	**.20**	**.35**	**.90**	.....
" **Alum**—see Aluminum Sodium Sulphate	....	....	....	.....
" **Aluminate C. P.**	**.20**	**.30**	**.85**	.....
" **Amalgam** about 5%	**.40**	**1.20**	**3.50**	.....
" **Ammonium Phosphate C. P.**	**.20**	**.35**	**.95**	.....
" " **Sulphate C. P.**	**.20**	**.30**	**.75**	.....
" **Arsenate** tech	**.20**	**.30**	**.75**	.....
" " cryst. **C. P.**	**.20**	**.35**	**1.05**	.....
" **Arsenite** tech	**.20**	**.30**	**.75**	.....
" " **C. P.**	**.20**	**.35**	**1.05**	.....
" **Benzenesulphonate** pure	**.20**	**.30**	**.75**	.....
" **Benzoate** powd. U. S. P	**.20**	**.35**	**1.00**	.....
Sodium Bicarbonate powd. U. S. P	....	....	**.20**	**.50**
" " " **C. P.**	....	**.25**	**.50**	**2.00**
" **Bichromate** cryst. tech	....	**.25**	**.45**	**1.60**
" " " **C. P.**	**.20**	**.35**	**.90**	.....
" **Binoxalate C. P.**	**.20**	**.50**	**1.50**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Sodium Biphosphate—see Sodium Phosphate Monobasic	....	....	....	.....
" **Bismuthate C. P.**	**$0.65**	**$1.85**	**$5.45**	.....
" **Bisulphate** tech	....	**.20**	**.30**	**$1.10**
" " cryst. **C. P.**	....	**.30**	**.65**	**2.75**
" " fused **C. P.**	....	**.35**	**.75**	.....
" **Bisulphite** pure dry	....	....	**.25**	**1.00**
" **C. P.**	....	**.30**	**.60**	**2.50**
" **Bitartrate C. P.**	**.20**	**.45**	**1.35**	.....
" **Borate** cryst. (Borax) pure	....	....	**.20**	**.80**
" " **C. P.**	....	**.25**	**.50**	**2.00**
" powd. pure	....	....	**.20**	**.80**
" " **C. P.**	....	**.25**	**.50**	**2.00**
" fused ground (Borax Glass)	....	**.25**	**.60**	.....
" **Bromate C. P.**	**.30**	**.80**	**2.50**	.....
" **Bromide** U. S. P	**.20**	**.30**	**.80**	.....
" **C. P.**	**.20**	**.40**	**1.10**	.....
" **Calcium Hydrate** dry 8 mesh	....	**.30**	**.60**	**2.50**
" " moist 8 mesh	....	**.35**	**.70**	**3.00**
" **Carbonate** cryst. tech. (Sal Soda) (Washing Soda)	....	....	**.20**	**.50**
" " pure	....	....	**.30**	**1.10**
" " **C. P.**	....	**.25**	**.50**	**1.80**
" Calcined tech. (Soda Ash)	....	....	**.20**	**.60**
" " dry pure	....	....	**.30**	**1.25**
" Anhyd. **C. P.**	....	**.30**	**.55**	**2.25**
" **Chlorate** cryst. tech	....	**.20**	**.30**	**1.25**
" " **C. P.**	....	**.35**	**.70**	.....
" **Chloride** white gran	....	....	**.20**	**.45**
" cryst. **C. P.**	....	**.25**	**.50**	**1.65**
" fused **C. P.**	....	**.35**	**.90**	.....
" **Chromate** neutral pure	**.20**	**.30**	**.65**	.....
" " **C. P.**	**.20**	**.40**	**1.10**	.....
" **Cinnamate** pure	**.60**	**1.75**	....	.....
" **Citrate** U. S. P	**.20**	**.30**	**.80**	.....
" **C. P.**	**.25**	**.45**	**1.25**	.....
" **Cobaltic Nitrite** dry **C. P.**	**.75**	**2.10**	**6.25**	.....
" **Cyanide** tech. 98%	....	**.30**	**.60**	**2.50**
" **C. P.**	**.20**	**.40**	**1.10**	.....
" **Ferrocyanide** tech	....	**.20**	**.55**	.....
" **C. P.**	**.20**	**.40**	**1.15**	.....
" **Fluoride** powd. tech	....	**.20**	**.35**	**1.40**
" **C. P.**	**.20**	**.40**	**1.20**	.....
" **Formate** pure	**.20**	**.35**	**1.05**	.....
" **C. P.**	**.25**	**.45**	**1.25**	.....
" **Hydrosulphite**	**.20**	**.35**	**1.05**	.....
" **Hydroxide** gran. tech	....	....	**.20**	**.75**
" sticks U. S. P	....	**.30**	**.60**	**2.25**
" " **C. P.**	....	**.35**	**.70**	**2.80**
" **Pellets** U. S. P	....	**.30**	**.60**	**2.25**
" " **C. P.**	....	**.35**	**.70**	**2.80**
" with Lime—see Sodium Calcium Hydrate	....	....	....	.....
" **Hypochlorite Solution**	....	....	**.45**	**1.75**
" **Hyposulphite** cryst. pea size	....	....	**.20**	**.70**
" " **C. P.**	....	**.30**	**.55**	**2.00**
" dry powd. **C. P.**	....	**.30**	**.65**	.....
" **Iodate C. P.**	**.80**	**2.40**	....	.....
" **Iodide** U. S. P	**.65**	**2.10**	**6.25**	.....
" **C. P.**	**.80**	**2.30**	**7.00**	.....
" **Metaphosphate C. P.**	**.30**	**.60**	**1.80**	.....
" **Molybdate C. P.**	**.35**	**.90**	**2.50**	.....
" **Nitrate** cryst. tech	....	....	**.20**	**.60**
" " pure	....	....	**.25**	**.90**
" " **C. P.**	....	**.30**	**.60**	**2.25**
" fused sticks **C. P.**	**.20**	**.40**	**1.10**	.....
" **Nitrite** gran. tech	....	**.20**	**.40**	**1.50**
" " U. S. P	....	**.25**	**.60**	**2.25**
" " **C. P.**	**.20**	**.30**	**.70**	.....
" sticks **C. P.**	**.20**	**.40**	**1.05**	.....
" **Nitroprusside C. P.**	**.55**	**1.65**	....	.....
" **Oleate** pure	**.20**	**.35**	**1.05**	.....
" **Oxalate** pure	**.20**	**.30**	**.90**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Sodium Oxalate C. P.	**$0.20**	**$0.45**	**$1.25**	.....
" **Perborate** U. S. P	....	**.25**	**.55**	.....
" **Peroxide** powd. pure	....	**.35**	**.75**	**$3.00**
" " **C. P.**	....	**.40**	**1.05**	**4.50**
" " fused lump (Oxone)	....	**.50**	**1.25**	2 lbs. **2.00**
" **Phosphate** Monobasic **C. P.** NaH_2PO_4	**.20**	**.40**	**.80**	.....
" " **Dibasic** tech	....	....	**.25**	**.85**
" " " gran. U. S. P	....	**.20**	**.35**	**1.50**
" " " cryst. **C. P.** Na_2HPO_4	....	**.30**	**.60**	**2.50**
" " " Anhyd. **C. P.**	**.30**	**.70**	**2.00**	.....
" " **Tribasic** tech	....	....	**.25**	**.85**
" " " **C. P.** Na_3PO_4	**.20**	**.40**	**.85**	.....
" **Phosphite C. P.**	**.50**	**1.35**	**4.25**	.....
" **Potassium Carbonate C. P.**	**.20**	**.40**	**1.15**	.....
" " **Tartrate** cryst. U. S. P	....	**.25**	**.50**	**2.00**
" " " " **C. P.**	**.20**	**.35**	**.95**	.....
" " " powd. U. S. P	....	**.25**	**.50**	**2.00**
" **Pyrophosphate C. P.**	**.20**	**.35**	**.90**	.....
" **Salicylate** powd. U. S. P	**.20**	**.35**	**.95**	.....
" **Silicate** dry powd. tech	....	**.20**	**.45**	**2.00**
" " solution tech. (Water Glass) 1 gal. **$1.25**	....	....	**.25**	**.60**
" " cryst. **C. P.**	**.25**	**.50**	**1.50**	.....
" **Silicofluoride C. P.**	**.20**	**.40**	**1.10**	.....
" **Stannate C. P.**	**.30**	**.85**	**2.50**	.....
" **Stearate** pure	**.20**	**.35**	**.90**	.....
" **Succinate** cryst. pure	**.30**	**.70**	**2.00**	.....
" **Sulphantimoniate**	**.20**	**.50**	**1.50**	.....
" **Sulphate** cryst. tech. (Glauber's Salt)	....	....	**.20**	**.50**
" " " pure	....	....	**.30**	**1.15**
" " " **C. P.**	....	**.25**	**.50**	**2.25**
" " dry powd. pure	....	....	**.30**	**1.25**
" " Anhyd. powd. **C. P.**	....	**.25**	**.50**	**2.25**
" **Sulphide** cryst. pure	....	**.30**	**.65**	**2.75**
" " " **C. P.**	....	**.30**	**.90**	.....
" " fused tech	....	**.25**	**.45**	.....
" **Sulphite** cryst. pure	....	....	**.30**	**1.25**
" " " **C. P.**	....	**.30**	**.55**	**2.25**
" " powd. pure	....	**.20**	**.30**	**1.35**
" " Anhyd. **C. P.**	....	**.30**	**.60**	**2.50**
" **Sulphocyanide C. P.**	**.25**	**.55**	**1.60**	.....
" **Tartrate** neutral **C. P.**	**.20**	**.45**	**1.30**	.....
" **Thiocyanate**—see Sodium Sulphocyanide	....	....	....	.....
" **Thiosulphate**—see Sodium Hyposulphite	....	....	....	.....
" **Tungstate** pure powd	**.30**	**.65**	**1.95**	.....
" " cryst. **C. P.**	**.30**	**.75**	**2.20**	.....
" **Uranate**—see Uranium Oxide yellow	....	....	....	.....
Sphagnum Moss	....	....	**.35**	**1.15**
Spermaceti U. S. P	....	**.35**	**.70**	.....
Starch Arrow-root	....	**.30**	**.60**	.....
" **Cassava** (Tapioca)	....	**.20**	**.45**	.....
" **Corn**	....	....	**.20**	**.75**
" **Iodized**	**.35**	**.95**	**2.75**	.....
" **Laundry, Lumpy**	....	....	**.20**	.....
" **Potato**	....	....	**.30**	**1.15**
" **Rice**	....	....	**.35**	.....
" **Soluble** tech	**.20**	**.30**	**.90**	.....
" " Acc. to Lintner	**.20**	**.40**	**1.10**	.....
" Wheat	....	....	**.35**	.....
Steel Shot (Punchings)	....	....	**.20**	**.75**
" **Wool** Medium	....	**.25**	**.55**	.....
Strontium Acetate C. P.	**.30**	**.75**	**2.25**	.....
" **Borate C. P.**	**.30**	**.70**	**2.05**	.....
" **Bromide** cryst. U. S. P	**.20**	**.35**	**1.00**	.....
" " " **C. P.**	**.25**	**.45**	**1.30**	.....
" **Carbonate** tech	....	**.20**	**.45**	.....
" " **C. P.**	**.20**	**.45**	**1.30**	.....
" **Chlorate** cryst. **C. P.**	**.35**	**.75**	**2.25**	.....
" **Chloride** cryst. pure	....	**.25**	**.50**	.....
" " **C. P.**	**.20**	**.35**	**.85**	.....
" **Chromate C. P.**	**.35**	**.95**	**2.80**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Strontium Fluoride C. P.	**$0.30**	**$0.60**	**$1.70**	.....
" **Hydroxide** cryst. **C. P.**	**.30**	**.50**	**1.50**	.....
" **Iodide** U. S. P	**.70**	....	....	.....
" **Nitrate** powd	....	**.20**	**.40**	**$1.60**
" " **C. P.**	**.20**	**.40**	**1.15**	.....
" **Oxalate C. P.**	**.35**	**.80**	**2.35**	.....
" **Oxide** Anhyd. **C. P.**	**.40**	**1.10**	**3.25**	.....
" **Perchlorate C. P.**	**.35**	**1.00**	**3.00**	.....
" **Phosphate C. P.**	**.35**	**.70**	**2.00**	.....
" **Sulphate C. P.**	**.20**	**.45**	**1.35**	.....
" **Sulphide** powd	**.20**	**.40**	**1.20**	.....
Strychnine Alkaloid cryst. U. S. P	**1.35**	....	....	1/8 oz. **.35**
" **Acetate** U. S. P	**1.35**	....	....	1/8 oz. **.35**
" **Hydrochloride** U. S. P	**1.35**	....	....	1/8 oz. **.35**
" **Nitrate** U. S. P	**1.35**	....	....	1/8 oz. **.35**
" **Sulphate** cryst. U. S. P	**1.30**	....	....	1/8 oz. **.35**
Sugar Burnt—see Caramel	....	....	....	.....
" **Cane**—see Saccharose	....	....	....	.....
" **Fruit**—see Levulose	....	....	....	.....
" **Grape**—see Dextrose	....	....	....	.....
" **Inverted**	**.20**	**.45**	**1.25**	.....
" **Lead**—see Lead Acetate	....	....	....	.....
" **Milk**—see Lactose	....	....	....	.....
Sulphur Flowers powd	....	....	**.20**	**.60**
" precip. U. S. P	....	**.20**	**.50**	.....
" roll (Brimstone)	....	....	**.20**	**.60**
" **Chloride**	....	**.45**	**.85**	**3.00**
" **Iodide** U. S. P	**.80**	....	....	.....
" **Trioxide**—see Acid Sulphurous Anhyd	....	....	....	.....
Superoxol—see Hydrogen Peroxide 30%	....	....	....	.....
Taka Diastase—see Diastase Taka	....	....	....	.....
Talcum powd. tech	....	....	**.20**	**.75**
" " U. S. P	....	....	**.30**	**1.25**
Tallow purif	....	**.35**	**.75**	.....
Tapioca—see Starch Cassava	....	....	....	.....
Tartar Emetic U. S. P	**.20**	**.30**	**.70**	.....
" " **C. P.**	**.25**	**.60**	**1.50**	.....
Tellurium Metal powd	**1.00**	**3.00**	....	.....
" **Nitrate** basic	**5.25**	....	....	.....
" **Oxide** di	**7.35**	....	....	1/4 oz. **2.45**
Test Lead—see Lead Metal	....	....	....	.....
" **Papers**—see page 499	....	....	....	.....
Thallium Metal	**2.00**	....	....	.....
" **Sulphate**	**4.50**	....	....	10 Gm. **1.75**
Theine—see Caffeine	....	....	....	.....
Thermit	....	**.35**	**.90**	**4.00**
" **Ignition Mixture**	....	....	....	1/2 lb. **.90**
Thorium Nitrate C. P.	**.60**	**1.75**	**5.40**	.....
" **Oxide** Anhyd. pure	**1.25**	....	....	.....
Thymol cryst. U. S. P	**.55**	**1.65**	**5.00**	.....
Tin Metal bars pure	**.20**	**.45**	**1.25**	.....
" " mossy gran. pure	**.20**	**.45**	**1.25**	.....
" " " **C. P.**	**.30**	**.65**	**1.90**	.....
" " shot	**.30**	**.55**	**1.55**	.....
" " sticks	**.30**	**.60**	**1.65**	.....
" " powd. **C. P.** 20 mesh	**.35**	**.70**	**2.00**	.....
" " " **C. P.** 30 mesh	**.35**	**.70**	**2.00**	.....
" " pure foil Pb free	**.35**	**.70**	**2.00**	.....
" **(ous) Acetate C. P.**	**.40**	**1.10**	**3.20**	.....
" **(ic) Chloride** cryst. **C. P.**	**.30**	**.50**	**1.40**	.....
" " " Anhyd. fuming	**.35**	**.75**	**1.75**	.....
" **(ous)** " cryst. pure	**.20**	**.35**	**.90**	.....
" " " " **C. P.**	**.30**	**.45**	**1.25**	.....
" " **Oxalate C. P.**	**.40**	**1.10**	**3.25**	.....
" " **Oxide** white pure	**.20**	**.35**	**1.00**	.....
" **(ic) Oxide** white **C. P.**	**.30**	**.55**	**1.60**	.....
" **(ous)** " black **C. P.**	**.45**	**1.15**	**3.45**	.....
" **(ic) Sulphate C. P.**	**.40**	**1.00**	**3.00**	.....
" **(ous)** " **C. P.**	**.45**	**1.25**	**3.70**	.....
" **(ic) Sulphide C. P.**	**.45**	**1.35**	**4.00**	.....
" **(ous)** " **C. P.**	**.55**	**1.65**	**5.00**	.....

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Titanium Metal 81%	**$0.40**	**$1.20**	**$3.50**	
" **(ic) Chloride Tetra**	**.40**	**1.00**	**3.00**	
" " **Oxide** Anhyd. **C. P.**	**.45**	**1.15**	**3.35**	
" **Potassium Oxalate** pure	**.30**	**.70**	**2.10**	
Tolidine pure	**.45**	**1.25**	**3.75**	
Toluene (Toluol) pure 1 pt. **$0.45**, 1 qt. **.75**, 1 gal. **$1.50**	....	**.25**	....	
" " **C. P.**	....	**.35**	**.65**	
Toluidine (Ortho) pure	**.20**	**.35**	**1.00**	
" (Para) pure	**.30**	**.75**	**2.25**	
Trioxymethylene—see Formaldehyde Para	....	....	....	
Trypsin powd	**1.40**	....	....	
Tungsten Metal powd. pure	**.35**	**.85**	**2.50**	
" **Oxide**—see Acid Tungstic	....	....	....	
Turmeric powd	....	**.20**	**.50**	
" **Paper**—see Test Paper page 499	....	....	....	
Turpentine Spirits—see Oil Turpentine	....	....	....	
" **Venice Artificial**	....	**.45**	**.90**	
Ultramarine Blue	....	**.25**	**.50**	
Uranium Acetate C. P. Na free	**.70**	**2.00**	....	
" **Nitrate** cryst. **C. P.**	**.70**	**2.00**	**6.00**	
" **Oxide Yellow** pure	**.65**	**1.90**	....	
Urea (Carbamide) pure	....	**.30**	**.75**	
Vanadium Chloride cryst	**1.50**	....	....	
" **Pentoxide**—see Acid Vanadic	....	....	....	
Vaseline—see Petrolatum	....	....	....	
Vinegar Cider	....	....	....	1 Qt. **$0.40**
Volumetric Solutions—see pages 498-499	....	....	....	
Washing Soda—see Sodium Carbonate	....	....	....	
Water Distilled	....	....	**.30**	1 Gal. **.75**
" **Ammonia**—see Ammonium Hydroxide	....	....	....	
" **Bromine**—see Bromine Water	....	....	....	
" **Chlorine**—see Chlorine Water	....	....	....	
" **Javelle**—see Sodium Hypochlorite	....	....	....	
" **Lime** ½ gal. **.75**	....	....	**.35**	1 Gal. **1.25**
" **Glass**—see Sodium Silicate Solution	....	....	....	
Wax Bees White U. S. P	....	**.45**	**1.20**	
" " Yellow U. S. P	....	**.35**	**.85**	
White Lead—see Lead Carbonate	....	....	....	
Whiting	....	....	**.20**	**.75**
Witch Hazel	....	....	**.50**	
Wood Alcohol—see Alcohol Methyl	....	....	....	
Wool Glass—see Glass Wool	....	....	....	
" **Mineral**—see Mineral Wool	....	....	....	
" **Steel**—see Steel Wool	....	....	....	
Xylol pure 1 pt. **.45**, 1 qt. **.75**, 1 gal. **1.65**	....	**.25**	**.45**	
" **C. P.**	....	**.30**	**.60**	**2.25**
Xylose C. P.	....	....	....	10 Gm. **3.35**
Yarn Woolen white	....	**1.00**	**3.00**	
Zinc Metal Cubes for Kipp Generator ⅜" x ⅜" x 1"	....	....	**.35**	**1.40**
" " Mossy Gran. tech	....	....	**.25**	**1.00**
" " " " **C. P.**	....	**.30**	**.60**	**2.50**
" " " " Arsenic Free **C. P.**	**.20**	**.40**	**1.10**	
" " Powd. Dust. tech	....	**.20**	**.35**	**1.30**
" " " " **C. P.**	....	**.30**	**.60**	**2.50**
" " " **C. P.** 20 mesh	....	**.35**	**.70**	**3.00**
" " " **C. P.** 30 mesh	....	**.35**	**.65**	**2.75**
" " Sheet 1/32"	....	....	**.45**	**1.75**
" " " 1/16"	....	....	**.40**	**1.60**
" " Shot **C. P.**	....	**.35**	**.85**	**4.00**
" " " Arsenic Free **C. P.**	**.20**	**.45**	**1.20**	
" " Stick **C. P.**	....	**.35**	**.85**	**4.00**
" " " Arsenic Free **C. P.**	**.20**	**.45**	**1.20**	
" **Acetate C. P.**	**.20**	**.35**	**1.05**	
" **Amalgam**	**.35**	**1.00**	**3.00**	
" **Ammonium Sulphate C. P.**	**.20**	**.35**	**1.00**	
" **Arsenate C. P.**	**.25**	**.60**	**1.75**	
" **Arsenite C. P.**	**.30**	**.75**	**2.25**	
" **Benzoate**	**.40**	**1.20**	....	
" **Borate C. P.**	**.35**	**.90**	**2.70**	
" **Bromide** U. S. P	**.40**	**.85**	**2.60**	

Prices include container.
No quantities smaller than those priced will be sold.

	1 oz.	4 oz.	1 lb.	5 lbs.
Zinc Carbonate Precip. tech	....	$0.25	$0.55	.....
" " **C. P.**	$0.25	.45	1.35	.....
" **Chloride** Gran. tech	....	.25	.45	$1.75
" " " U. S. P	....	.30	.65	2.85
" " " **C. P.**	.20	.35	.80	3.65
" " Fused Stick **C. P.**	.20	.40	1.10	.....
" **Chromate C. P.**	.30	.70	2.05	.....
" **Cyanide** pure	.20	.35	1.10	.....
" **Ferrocyanide** pure	.50	....	....	.....
" **Hydroxide C. P.**	.25	.50	1.40	.....
" **Iodide** U. S. P	.85	....	....	.....
" **Nitrate** cryst. tech	....	.30	.60	.....
" " **C. P.**	.20	.35	.90	.....
" " Fused **C. P.**	.30	.70	2.00	.....
" **Oxalate C. P.**	.35	.85	2.50	.....
" **Oxide** tech	....	.20	.35	1.35
" " U. S. P	....	.25	.50	.....
" " Dry Process **C. P.**	.20	.35	.80	.....
" " Wet Process **C. P.**	.20	.40	1.00	.....
" **Permanganate** Pure Dry	.70	1.95	....	.....
" **Peroxide**	.35	1.00	3.00	.....
" **Phosphate C. P.**	.30	.70	2.00	.....
" **Phosphide**	.30	.70	2.00	.....
" **Salicylate**	.30	.90	2.80	.....
" **Stearate** U. S. P	....	.25	.65	.....
" **Sulphate** Cryst. tech	....	....	.25	.75
" " " U. S. P	....	....	.35	1.50
" " " **C. P.**	....	.30	.55	2.35
" " Anhyd. pure	....	.20	.40	.....
" " " **C. P.**	.20	.35	.95	.....
" **Sulphide** Powd. tech	.20	.40	1.10	.....
" " " pure	.25	.50	1.45	.....
" " " **C. P.**	.40	1.15	3.25	.....
" " **Phosphorescent**	3.25	....	....	.....
" **Sulphite** pure	.25	.45	1.35	.....
" **Tartrate C. P.**	.90	....	....	.....
Zirconium Nitrate C. P.	.85	....	....	.....
" **Oxide C. P.**	.40	1.10	3.25	.....

Solutions Indicator

	1 oz.	4 oz.	1 lb.
Acid Rosolic	$0.30	$0.70	$2.00
Cochineal	.30	.60	1.75
Indigo	.30	.60	1.80
Litmus	.25	.50	1.50
Methyl Orange	.25	.50	1.50
" **Red**	.30	.70	2.00
Phenolphthalein	.30	.60	1.75
Turmeric	.30	.60	1.75

List of Reagents to Accompany: McPherson & Henderson's Laboratory Exercises

All Reagents Are in Glass Stoppered Bottles

Reagents for Each Desk

	250 cc	500 cc
Ammonium Hydroxide C. P.	$0.50	$0.90
Hydrochloric Acid C. P.	.50	.90
Nitric Acid C. P.	.50	.90
Sodium Hydroxide 10% Solution	.50	.90
Sulphuric Acid C. P.	.50	.90

Reagents for Use of All Students

Acetic Acid 36%	.50	.90
Aluminum Sulphate 10% Solution	.60	1.05
Ammonium Carbonate 10% Solution	.60	1.05
" **Chloride 10% Solution**	.60	1.05

Prices include container.
No quantities smaller than those priced will be sold.

Reagents for Use of All Students (Continued)

	250 cc	500 cc
Ammonium Molybdate Solution	$0.90	$1.60
" Sulphide Solution	.50	.90
Barium Chloride 10% Solution	.60	1.05
	250 gm.	500 gm.
Borax (Solid)	.45	.75
	250 cc	500 cc
Calcium Chloride 10% Solution	.60	1.05
Carbon Tetrachloride	.50	.90
Chloroform U. S. P.	.65	1.20
Chlorine Water	.60	1.05
Chromium Sulphate 10% Solution	.70	1.30
Cobalt Nitrate 5% Solution	.70	1.30
Copper Sulphate 10% Solution	.60	1.05
Disodium Phosphate 10% Solution	.60	1.05
Fehling Solution A	.60	1.05
" " B	.65	1.20
Ferric Chloride 10% Solution	.60	1.05
" Sulphate 10% Solution	.60	1.05
Hydrogen Sulphide Solution	.60	1.05
Iodine Solution	.70	1.30
Lead Acetate 10% Solution	.60	1.05
	1000 cc	2000 cc
Limewater	.80	1.40
	250 cc	500 cc
Litmus Indicator Solution	.80	1.50
Magnesium Sulphate 10% Solution	.60	1.05
Manganese Chloride 10% Solution	.60	1.05
Mercuric Chloride 5% Solution	.70	1.30
Mercurous Nitrate 10% Solution	.75	1.40
Phenolphthalein Indicator Solution	1.00	1.90
Potassium Bromide 10% Solution	.60	1.05
" Chromate 10% Solution	.60	1.05
" Ferrocyanide 10% Solution	.60	1.05
" Hydroxide 10% Solution	.60	1.05
" Iodide 10% Solution	1.00	1.90
" Sulphocyanide 10% Solution	.60	1.05
Silver Nitrate 4% Solution	1.00	1.90
Starch Solution	.70	1.30
Sodium Carbonate 10% Solution	.60	1.05
	250 gm.	500 gm.
" Chloride Solid	.45	.75
	250 cc	500 cc
" Thiosulphate 10% Solution	.60	1.05
Zinc Acetate 10% Solution	.60	1.05

Solutions—Standard Volumetric

Standardized according to International Atomic Weights, Oxygen-16.
These solutions are corrected to +0.05% C when shipped.
Caution: Volumetric solutions should be stored in a cool place, and solutions which have been on hand for a considerable time should be rechecked if great accuracy is desired.

Acid Hydrochloric Normal	1 liter g. s. b., each	$2.00
" " Tenth Normal	½ liter g. s. b., each	1.30
	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
" Oxalic Fifth Normal	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
" Sulphuric Normal	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
" " Tenth Normal	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
Ammonium Sulphocyanate Tenth Normal	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
Iodine Tenth Normal	1 liter g. s. b., each	2.25
	½ liter g. s. b., each	1.50
Potassium Permanganate Fifth Normal	1 liter g. s. b., each	2.00
	½ liter g. s. b., each	1.30
Silver Nitrate Tenth Normal	1 liter g. s. b., each	2.25
	½ liter g. s. b., each	1.30

Prices include container.
No quantities smaller than those priced will be sold.

Solutions—Standard Volumetric—(Continued)

		1 liter g. s. b., each	**$2.00**
Sodium Hydroxide Normal		½ liter g. s. b., each	**1.30**
		1 liter g. s. b., each	**2.00**
" Thiosulphate Tenth Normal		½ liter g. s. b., each	**1.30**

Solutions

For Special Test Purposes

	1 oz.	4 oz.	1 lb.
Barfoed's Sugar	$0.25	$0.45	$1.25
Benedict's Solution	.30	.60	1.60
Boas' HCL in Gastric Juice	.30	.65	1.75
Dobbin's Caustic Alkalies	.30	.60	1.60
Esbach's Albumen	.20	.40	1.00
Fehling's No. 1 Sugar	.20	.35	.70
Fehling's No. 2 Sugar	.20	.40	1.00
Haine's Glucose	.20	.45	1.15
Mayer's Alkaloids	.25	.55	1.50
Millon's Albumen	.25	.55	1.50
Nessler's Ammonia and Aldehyde	.30	.65	1.75
Nylander's Glucose	.25	.55	1.50
Obermayer's Indican	.25	.45	1.25
Schultze's Alkaloids	.30	.65	1.75
Schweitzer's Cellulose	.30	.65	1.75

Test Papers

Books 25 Strips

Litmus Blue	$0.06	Each	$0.50	Doz.
" Neutral	.06	"	.50	"
" Red	.06	"	.50	"

Sheets 8 inch x 10 inch

Azolitmin	$0.15	Each	$1.30	Quire
Cochineal	.12	"	1.10	"
Congo Red	.08	"	.75	"
Lacmoid	.12	"	1.10	"
Lead Acetate	.08	"	.75	"
Litmus Blue	.08	"	.75	"
" Neutral	.08	"	.75	"
" Red	.08	"	.75	"
Logwood	.12	"	1.10	"
Methyl Orange	.08	"	.75	"
" Red	.15	"	1.30	"
Phenolphthalein	.10	"	.95	"
Potassium Iodide	.10	"	.95	"
" " Starch	.10	"	.95	"
Starch	.10	"	.95	"
Turmeric	.10	"	.95	"

Vials 100 Strips

Azolitmin	.15	Each	1.40	Doz.
Cochineal	.12	"	1.25	"
Congo Red	.10	"	.85	"
Lacmoid	.12	"	1.25	"
Lead Acetate	.10	"	.85	"
Litmus Blue	.10	"	.85	"
" Neutral	.10	"	.85	"
" Red	.10	"	.85	"
Logwood	.12	"	1.25	"
Methyl Orange	.10	"	.85	"
" Red	.15	"	1.40	"
Phenolphthalein	.12	"	1.25	"
Potassium Iodide	.12	"	1.25	"
" " Starch	.12	"	1.25	"
Starch	.12	"	1.25	"
Turmeric	.10	"	.85	"

Fertilizers

Set of Fertilizer Samples, 12 to set, in 4 oz. Screw Cap Jars. **Price per set $3.35**

	1 lb.	5 lbs.
Acid Phosphate	$0.20	$0.60
Ammonium Phosphate	.45	2.00
" Sulphate	.20	.65
Bone Meal	.20	.40
Dried Blood	.25	.70
Guano	.30	1.25
Kainit	.20	.60
Land Plaster	.20	.50
Muriate of Potash	.30	1.25
Nitrate of Soda	.20	.60
Rock Phosphate	.20	.45
Sulphate of Potash	.30	1.25

Soils

	1 lb.	5 lbs.
Acid Soil	$0.20	$0.75
Black Loam Rich	.20	.75
Clay	.20	.75
" **Drab**	.20	.75
Field Sand	.20	.75
Gravel, washed	20	.75
Humus Soil	.20	.75
Leaf Mould	.20	.75
Muck Soil	.20	.75
Peat Soil	.20	.75
Propagating Sand	.20	.75
Saw Dust, for germination	.25	.95
Sandy Loam	.20	.75
Silt Loam	.20	.75
Sphagnum Moss	.35	1.15
White Sand	.20	.75

Insecticides and Fungicides

	¼ lb.	1 lb.
Arsenate of Lead, dry powd	$0.30	$0.50
" " **Soda,** dry	.35	.70
Bordeaux Mixture, dry	....	.65
Carbon Disulphide	.25	.45
Copper Sulphate, powd	....	.30
Dichloricide	.25	.60
Fish Oil Soap (Whale Oil Soap)	....	.50
Hellebore, powd., white	.30	.60
London Purple	.30	.60
Paris Green	.30	.60
Pyrethrum (Persian Insect Powder)	.35	.80
Quick Lime, in tin can	....	.20
Sulphur Flowers, powd	....	.20
Tobacco Stems	....	.35

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